



Project Manual
for
EYECARE MEDICAL GROUP
53 SEWALL STREET
PORTLAND, ME 04102

E.M.G. - Phase 2 Addition & Renovation

VOLUME 1

Site and Foundation Package
June 13, 2013



ARCHITECTURE
INTERIOR DESIGN
PLANNING
A R C H I T E C T S

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By Construction Manager

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SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:

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

- B. Related Sections include the following:

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

1.3 PROJECT INFORMATION

- A. Project Identification: Eyecare Medical Group Phase 2 – Addition & Renovation.

1. Project Location: 53 Sewall Street, Portland, Me 04102.

- B. Owner: Eyecare Medical Group.

- C. Architect Identification: The Contract Documents were prepared for Project by PDT Architects, 49 Dartmouth Street, Portland, Maine 04101. Telephone 207-775-1059.

- D. Construction Manager: M. R. Brewer, 91 Bell Street, Portland, ME 04103 Tel: 207-797-7534.

1. Construction Manager for this Project is Project's Constructor. In Divisions 01 through 49 Sections, the terms "Construction Manager" and "Contractor" are synonymous.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work consists of the following:

1. The Work involves the construction of a new Addition and Renovations to the existing Eyecare Medical Group at location indicated on Drawings. Work includes but is not limited to, selective demolition, earthwork, site utilities and site improvements, paving and landscaping. Work also includes concrete foundations and slab-on-grade, steel structure, steel joists and decking, roof membrane over roof insulation, sheet metal, masonry, metal stud partitions, insulation, gypsum board walls and ceilings, ceramic tile, acoustical ceilings, resilient flooring, carpeting, custom cabinets and fixtures, carpentry, glass storefront system, painting, metal doors, wood doors, metal frames, door hardware, toilet accessories, signage, lockers, loading dock equipment, fire protection and detection systems, security systems, electrical, and heating, ventilating, and air conditioning complete and ready for use.

1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in multiple phases and in the following order, with each phase as indicate to be substantially complete before beginning the next phase:

Phase:

0. Generator Replacement Project (commences as separate contract, while completion takes place in tandem with the electrical work of this addition and renovation)
1. Site & Foundation Substantially Complete
 - a. Coordinate parking lot work with Owner's operations
 - b. Underslab utilities prepared to receive work in phases described below
2. Structural Steel Package
3. Complete Building Envelope & required interior infrastructure renovations
 - a. Mechanical/Electrical Room as required. Accommodate electrical requirements and med. gas. Relocation.
 - b. New Med. Gas Room functional.
 - c. Exam Pod Envelope
 - d. OR Envelope
4. Area A Substantial Completion
 - a. Exam pod addition including waiting room area
 - b. Area A exterior demolition & interior renovation
5. Area B Existing OR 99' addition (area B) demolition and interior renovation
 - a. Existing OR surgery suite and locker room renovation work. Coordinate timeframe with project requirements and Owner's operations.
6. Area B OR Addition Substantial Completion

Phasing Notes:

Limit disruption to Owner's operations. Be fully aware that this facility is an operational eye surgery center and eye care clinic.

Coordinate working hours. Noise, vibration, dust and odors may not disrupt Owner's operations without prior approval. Maintain all utilities service including but not limited to domestic water, fire sprinkler service, plumbing, HVAC, electricity, emergency generator service.

Provide temporary partitions & means of egress as required throughout the project.

- B. Before commencing Work of each phase, submit a schedule showing the sequence, commencement and completion dates, and move-out and -in dates of Owner's personnel for all phases of the Work.

1.6 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
 - 1. Security and Communication systems.

1.7 ACCESS TO SITE

- A. General: Contractor shall have limited use of premises for construction operations as indicated on Drawings by the Contract limits.
- B. Use of Site: Limit use of premises to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 - 1. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

- A. Partial Owner Occupancy: Owner will occupy the premises during entire construction period, with the exception of areas under construction. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's operations. Maintain existing exits, unless otherwise indicated.

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

1.9 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
 1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Work shall be generally performed during normal business working hours, except as required to limit Owner's operations disruption or otherwise indicated. GC to verify acceptable hours of work per city ordinance and other applicable restrictions.
 1. Weekend Hours: GC to coordinate.
 2. Early Morning Hours: As approved by Architect and Owner.
 3. Hours for Utility Shutdowns: As approved by Architect and Owner.
 4. Hours for core drilling or noisy activity: As approved by Architect and Owner.
 5. Provide 24 hour notice to Architect when performing work other than normal working hours.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
 1. Notify Owner not less than two days in advance of proposed utility interruptions.
 2. Do not proceed with utility interruptions without Owner's written permission.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
 1. Notify Owner not less than two days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Drugs, Alcohol, Substance Abuses, and Firearms: It is strictly prohibited to possess, use, conceal, transport, traffic any drugs, alcohol, controlled substances, or firearms on the premises. Any violations shall be grounds for dismissal and may be cause for termination of any contracts or portions thereof.

1.10 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.
- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
 - 2. Include the cost of allowances in the contract bid price.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Quantity allowances.
- C. Related Sections include the following:
 - 1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders for allowances.
 - 2. Division 01 Section "Unit Prices" for procedures for using unit prices.
 - 3. Division 01 Section "Quality Requirements" for procedures governing the use of allowances for testing and inspecting.
 - 4. Divisions 02 through 48 Sections for items of Work covered by allowances.

1.3 SELECTION AND PURCHASE

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

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

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

1.6 COORDINATION

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

1.7 LUMP-SUM ALLOWANCES

- A. Allowance shall include cost to Contractor of specific products and materials selected by Architect under allowance and shall include taxes, freight, and delivery to Project site.
- B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials selected by Architect under allowance shall be included as part of the Contract Sum and not part of the allowance.
- C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.
 - 1. If requested by Architect, retain and prepare unused material for storage by Owner. Deliver unused material to Owner's storage space as directed.
- D. Return unused Lump Sum amounts for credit to Owner in their entirety.

1.8 ADJUSTMENT OF ALLOWANCES

- A. Allowance Adjustment: To adjust allowance amounts, prepare a Change Order proposal based on the difference between purchase amount and the allowance, multiplied by final measurement of work-in-place where applicable. If applicable, include reasonable allowances for cutting losses, tolerances, mixing wastes, normal product imperfections, and similar margins.
 - 1. Include installation costs in purchase amount only where indicated as part of the allowance.

2. If requested, prepare explanation and documentation to substantiate distribution of overhead costs and other margins claimed.
 3. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to unit-cost allowances.
 4. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.
- B. Submit claims for increased costs because of a change in scope or nature of the allowance described in the Contract Documents, whether for the purchase order amount or Contractor's handling, labor, installation, overhead, and profit.
1. Do not include Contractor's or subcontractor's indirect expense in the Change Order cost amount unless it is clearly shown that the nature or extent of work has changed from what could have been foreseen from information in the Contract Documents.
 2. No change to Contractor's indirect expense is permitted for selection of higher- or lower-priced materials or systems of the same scope and nature as originally indicated.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

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

3.3 SCHEDULE OF ALLOWANCES

- A. Allowance No. 1: Lump-Sum Allowance: Include the sum indicated in Section 260100 for Central Maine Power work.
- B. Allowance No. 2: Lump-Sum Allowance: Include the sum of \$5,000 for interior and exterior signage.

END OF SECTION 012100

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
 - 1. Division 01 Section "Allowances" for products selected under an allowance.
 - 2. Divisions 02 through 48 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use facsimile of form provided at end of this Section.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
 - b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.

- c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
 - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.
- B. Products with asbestos: Asbestos containing materials are not to be purchased or installed in this project.

1.6 PROCEDURES

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

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon 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. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
- c. Substitution request is fully documented and properly submitted.
- d. Requested substitution will not adversely affect Contractor's construction schedule.
- e. Requested substitution has received necessary approvals of authorities having jurisdiction.
- f. Requested substitution is compatible with other portions of the Work.
- g. Requested substitution has been coordinated with other portions of the Work.
- h. Requested substitution provides specified warranty.
- i. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Architect will consider requests for substitution if received within 60 days after commencement of the Work. Requests received after that time may be considered or rejected at discretion of Architect.

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

- a. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include

- compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
- b. Requested substitution does not require extensive revisions to the Contract Documents.
 - c. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - d. Requested substitution provides sustainable design characteristics that specified product provided.
 - e. Substitution request is fully documented and properly submitted.
 - f. Requested substitution will not adversely affect Contractor's construction schedule.
 - g. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - h. Requested substitution is compatible with other portions of the Work.
 - i. Requested substitution has been coordinated with other portions of the Work.
 - j. Requested substitution provides specified warranty.
 - k. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 3 - EXECUTION (Not Used)

SUBSTITUTION REQUEST FORM

Project: _____ Substitution Request Number: _____
To: _____ From: _____
Re: _____ Date: _____

Specification Title: _____ Description: _____
Section: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____
Manufacturer: _____ Address: _____ Phone: _____
Trade Name: _____ Model No. _____

Attached data includes product description, specifications, drawings, and performance and test data adequate for evaluation of the request: applicable portions of the data are clearly identified.

Attached data also includes a description of changes to the Contract Documents that the proposed substitutions will require for its proper installation.

The Undersigned certifies:

1. Has investigated proposed Product and determined that it meets or exceeds the quality level of the specified product.
2. Will provide the same warranty for the Substitution as for the specified Product.
3. Will provide no additional cost to the Owner.
4. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
5. Waive claims for additional costs or time extension that may subsequently become apparent.
6. Will reimburse Owner and Architect/Engineer for review or redesign services associated with substitution.

Submitted By: _____
Signed By: _____
Firm: _____
Address: _____
Telephone: _____ Fax: _____

A/E's REVIEW AND ACTION

- Submission approved - Make submittals in accordance with Specification Section 013300.
 Submission approved as noted - Make submittals in accordance with Specification Section 013300.
 Submission rejected - Use specified materials.
 Submission request received too late - Use specified materials.

Signed by: _____ Date: _____

Supporting Data Attached: Drawings Product Data Samples Tests Reports
 Other _____

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Sections include the following:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within 20 days 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 unforeseen conditions require modifications to the Contract, Contractor may propose changes 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 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use CSI Form 13.6A, "Change Order Request (Proposal)," with attachments CSI Form 13.6D, "Proposal Worksheet Summary," and Form 13.6C, "Proposal Worksheet Detail."

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: Refer to Division 01 Section "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

1.6 CHANGE ORDER PROCEDURES

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

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Allowances" for procedural requirements governing handling and processing of allowances.
 - 2. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3. Division 01 Section "Construction Progress Documentation" for administrative requirements governing preparation and submittal of Contractor's Construction Schedule and Submittals Schedule.

1.3 DEFINITIONS

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

1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with Continuation Sheets.
 - b. Submittals Schedule.
 - c. Items required to be indicated as separate activities in Contractor's construction schedule.
 - 2. Submit the Schedule of Values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

3. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values correlated with each element.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the Schedule of Values:
 - a. Project name and location.
 - b. Name of Architect.
 - c. Architect's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange schedule of values consistent with format of AIA Document G703.
 3. Arrange the Schedule of Values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide several line items for principal subcontract amounts, where appropriate. Include separate line items under required principal subcontracts for operation and maintenance manuals, punch list activities, Project Record Documents, and demonstration and training in the amount of 5 percent of the Contract Sum.
 - a. Include separate line items under Contractor and principal subcontracts for project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
 5. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 6. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If specified, include evidence of insurance or bonded warehousing.

7. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
8. Allowances: Provide a separate line item in the Schedule of Values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
9. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the Schedule of Values or distributed as general overhead expense, at Contractor's option.
10. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction Work covered by each Application for Payment is the period indicated in the Agreement.
 1. Submit draft copy of Application for Payment seven days prior to due date for review by Architect.
- C. Payment Application Forms: Use AIA Document G702 and AIA Document G703 Continuation Sheets as form for Applications for Payment.
- D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
 1. Entries shall match data on the Schedule of Values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.

1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- F. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- G. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's liens from subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit final or full waivers.
 3. The list of subcontractors, principal suppliers and fabricators shall be used to designate which entities involved in the Work must submit waivers. The list shall be approved by the Owner.
 4. Submit final Application for Payment with or preceded by 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 waivers of lien on forms, executed in a manner acceptable to Owner.
- H. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
 2. Schedule of Values.
 3. Contractor's Construction Schedule (preliminary if not final).
 4. Submittals Schedule (preliminary if not final).
 5. List of Contractor's staff assignments.
 6. Copies of building permits.
 7. Initial progress report.
 8. Report of preconstruction conference.
 9. Certificates of insurance and insurance policies.
 10. Performance and payment bonds.
 11. Data needed to acquire Owner's insurance.

- I. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
 - 1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

- J. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
 - 1. Evidence of completion of Project closeout requirements.
 - 2. Final submittal of record documents and operation and maintenance data.
 - 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 - 4. Updated final statement, accounting for final changes to the Contract Sum.
 - 5. Evidence that claims have been settled.
 - 6. 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.
 - 7. Final, liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Project meetings.
 - 4. Requests for Interpretation (RFIs).
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility will be assigned to a specific contractor.
- C. Related Sections include the following:
 - 1. Division 01 Section "Construction Progress Documentation" for preparing and submitting Contractor's Construction Schedule.
 - 2. Division 01 Section "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

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

1.4 INFORMATIONAL SUBMITTALS

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

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

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that depend on each other for proper installation, connection, and operation.
 - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
 - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
 - 1. Preparation of Contractor's Construction Schedule.
 - 2. Preparation of the Schedule of Values.
 - 3. Installation and removal of temporary facilities and controls.
 - 4. Delivery and processing of submittals.
 - 5. Progress meetings.
 - 6. Preinstallation conferences.
 - 7. Project closeout activities.
 - 8. Startup and adjustment of systems.
- D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

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

1.6 REQUESTS FOR INTERPRETATION (RFIs)

- A. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in form specified.
 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing interpretation and the following:
 1. Project name.
 2. Project number.
 3. Date.
 4. Name of Architect and Construction Manager.
 5. RFI number, numbered sequentially.
 6. RFI subject.
 7. Specification Section number and title and related paragraphs, as appropriate.
 8. Drawing number and detail references, as appropriate.
 9. Field dimensions and conditions, as appropriate.
 10. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 11. Contractor's signature.
 12. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Architect.
 1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. RFIs received after 1:00 p.m. will be considered as received the following working day.
 1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for 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 RFIs with numerous errors.
2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
 3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
1. Project name.
 2. Name and address of Architect and Construction Manager.
 3. RFI number including RFIs that were dropped and not submitted.
 4. RFI description.
 5. Date the RFI was submitted.
 6. Date Architect's response was received.
 7. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 8. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

1.7 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
 3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner, Construction Manager, and Architect, but no later

than 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.

1. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Tentative construction schedule.
 - b. Phasing.
 - c. Critical work sequencing and long-lead items.
 - d. Designation of key personnel and their duties.
 - e. Procedures for processing field decisions and Change Orders.
 - f. Procedures for RFIs.
 - g. Procedures for testing and inspecting.
 - h. Procedures for processing Applications for Payment.
 - i. Distribution of the Contract Documents.
 - j. Submittal procedures.
 - k. Preparation of Record Documents.
 - l. Use of the premises and existing building.
 - m. Work restrictions.
 - n. Working hours.
 - o. Owner's occupancy requirements.
 - p. Responsibility for temporary facilities and controls.
 - q. Procedures for moisture and mold control.
 - r. Procedures for disruptions and shutdowns.
 - s. Construction waste management and recycling.
 - t. Parking availability.
 - u. Office, work, and storage areas.
 - v. Equipment deliveries and priorities.
 - w. First aid.
 - x. Security.
 - y. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
 - a. The Contract Documents.
 - b. Options.

- c. Related RFIs.
 - d. Related Change Orders.
 - e. Purchases.
 - f. Deliveries.
 - g. Submittals.
 - h. Review of mockups.
 - i. Possible conflicts.
 - j. Compatibility problems.
 - k. Time schedules.
 - l. Weather limitations.
 - m. Manufacturer's written recommendations.
 - n. Warranty requirements.
 - o. Compatibility of materials.
 - p. Acceptability of substrates.
 - q. Temporary facilities and controls.
 - r. Space and access limitations.
 - s. Regulations of authorities having jurisdiction.
 - t. Testing and inspecting requirements.
 - u. Installation procedures.
 - v. Coordination with other work.
 - w. Required performance results.
 - x. Protection of adjacent work.
 - y. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
 4. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present.
 5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at monthly intervals. Coordinate dates of meetings with preparation of payment requests.
1. Attendees: In addition to representatives of Owner, Construction Manager, 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- 1) Review schedule for next period.
- b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Progress cleaning.
 - 10) Quality and work standards.
 - 11) Status of correction of deficient items.
 - 12) Field observations.
 - 13) Status of RFIs.
 - 14) Status of proposal requests.
 - 15) Pending changes.
 - 16) Status of Change Orders.
 - 17) Pending claims and disputes.
 - 18) Documentation of information for payment requests.
3. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- E. Project Closeout Conference: Construction Manager will schedule and conduct a Project closeout conference, at a time convenient to Owner and Architect, but no later than 60 days prior to the scheduled date of Substantial Completion.
 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Requirements for preparing sustainable design documentation.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for demonstration and training.
 - g. Preparation of Contractor's punch list.

- h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - i. Submittal procedures.
 - j. Coordination of separate contracts.
 - k. Owner's partial occupancy requirements.
 - l. Installation of Owner's furniture, fixtures, and equipment.
 - m. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- F. Coordination Meetings: Conduct Project coordination meetings at regular intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
 1. Attendees: 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 conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to Combined Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - b. Schedule Updating: Revise Combined Contractor's Construction Schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each contractor present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
 3. Reporting: Record meeting results and distribute copies to Architect and everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Start-up construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Field condition reports.
 - 7. Special reports.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting schedules and reports.
 - 2. Division 01 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- C. Event: The starting or ending point of an activity.
- D. Float: The measure of leeway in starting and completing an activity.

1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. PDF electronic file.
- B. Start-up construction schedule.
- C. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
- D. Construction Schedule Updating Reports: Submit with Applications for Payment.
- E. Daily Construction Reports: Submit at weekly intervals.
- F. Material Location Reports: Submit at monthly intervals.
- G. Field Condition Reports: Submit at time of discovery of differing conditions.
- H. Special Reports: Submit at time of unusual event.
- I. Qualification Data: For scheduling consultant.

1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Discuss constraints, including phasing, work stages, area separations and milestones.
 - 2. Review schedule for work of Owner's separate contracts.
 - 3. Review time required for review of submittals and resubmittals.
 - 4. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 5. Review time required for completion and startup procedures.
 - 6. Review and finalize list of construction activities to be included in schedule.
 - 7. Review submittal requirements and procedures.
 - 8. Review procedures for updating schedule.

1.6 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from parties involved.

2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of Final Completion.
 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
 2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
 4. Startup and Testing Time: Include not less than 5 days for startup and testing.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
 1. Phasing: Arrange list of activities on schedule by phase.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 3. Work Restrictions: Show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.

4. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Startup and placement into final use and operation.
 5. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
 - a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- E. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.
 3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
- F. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

2.2 START-UP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for commencement of the Work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60

days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

2.3 CONTRACTOR'S CONSTRUCTION SCHEDULE (GANTT CHART)

- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal Gantt-chart-type, Contractor's Construction Schedule within 30 days of date established for commencement of the Work. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
 - 1. For construction activities that require 3 months or longer to complete, indicate an estimated completion percentage in 10 percent increments within time bar.

2.4 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 - 1. List of subcontractors at Project site.
 - 2. List of separate contractors at Project site.
 - 3. Approximate count of personnel at Project site.
 - 4. Equipment at Project site.
 - 5. Material deliveries.
 - 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 - 7. Accidents.
 - 8. Meetings and significant decisions.
 - 9. Unusual events (refer to special reports).
 - 10. Stoppages, delays, shortages, and losses.
 - 11. Meter readings and similar recordings.
 - 12. Emergency procedures.
 - 13. Orders and requests of authorities having jurisdiction.
 - 14. Change Orders received and implemented.
 - 15. Construction Change Directives received and implemented.
 - 16. Services connected and disconnected.
 - 17. Equipment or system tests and startups.
 - 18. Partial completions and occupancies.
 - 19. Substantial Completions authorized.
- B. Material Location Reports: At monthly intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 - 1. Material stored prior to previous report and remaining in storage.

2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.5 SPECIAL REPORTS

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

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. Contractor's Construction Schedule Updating: At monthly intervals, review schedule for actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Actual Completion percentage for each activity.
- C. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.

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

END OF SECTION 013200

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
 3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
 4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Architect's final release or approval.
 - g. Scheduled date of fabrication.
 - h. Scheduled dates for purchasing.
 - i. Scheduled dates for installation.
 - j. Activity or event number.
- B. Arrange to have all submittals processed to the Architect within 90 days.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals, if requested.
1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
 2. Contractors requesting files shall sign the "Electronic Files Request Form and Waiver" and submit agreement included at the end of this section.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.

2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 28 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow 28 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
 - a. Sitework submittals.
 - b. Commercial equipment submittals.
 - c. Structural submittals.
 - d. Mechanical submittals.
 - e. Electrical submittals.
 - f. Data & Communications Systems submittals.
 5. Submittals with Color Selections:
 - a. The Contractor shall deliver to Architect a list of submittals for the interior color package and a list for the exterior color package.
 - b. Submittals with Color Selections - Exterior: The Contractor shall deliver all items for exterior color selection at one time. The Architect needs to coordinate the colors of all exterior items and the Contractor shall allow 4 weeks for return of exterior color selections.
 - c. Submittals with Color Selections - Interior: The Contractor shall deliver all items for interior color selection at one time. The Architect needs to coordinate the colors of all interior items and the Contractor shall allow 6 weeks for return of interior color selections.
- D. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

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

- I. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with “Reviewed” or “Furnish as Corrected” notation from Architect's action stamp.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 1. Post electronic submittals as PDF electronic files directly to Architect's FTP site specifically established for Project.
 - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
 2. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
 - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
 - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 1. If information must be specially prepared for submittal because standard published data are not suitable for use, submit as Shop Drawings, not as Product Data.
 2. Mark each copy of each submittal to show which products and options are applicable.
 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.

- c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 5. Submit Product Data before or concurrent with Samples.
 6. Submit Product Data in the following format:
 - a. PDF electronic file.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data, unless submittal based on Architect's digital data drawing files is otherwise permitted.
 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
 3. Submit Shop Drawings in the following format:
 - a. PDF electronic file.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
 1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
 2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
 - e. Specification paragraph number and generic name of each item.
 3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
 4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.

- a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
5. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
- a. Number of Samples: Submit one full set(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.
6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
- a. Number of Samples: Submit three sets of Samples. Architect will retain two Sample sets; remainder will be returned. Mark up and retain one returned Sample set as a project record sample.
 - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Contractor's Construction Schedule: Comply with requirements specified in Division 01 Section "Construction Progress Documentation."
- F. Application for Payment and Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Division 01 Section "Quality Requirements."
- H. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Division 01 Section "Closeout Procedures."
- I. Maintenance Data: Comply with requirements specified in Division 01 Section "Operation and Maintenance Data."
- J. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.

- K. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- L. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
- M. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- N. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- O. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- P. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- Q. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
- R. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - 1. Name of evaluation organization.
 - 2. Date of evaluation.
 - 3. Time period when report is in effect.
 - 4. Product and manufacturers' names.
 - 5. Description of product.
 - 6. Test procedures and results.
 - 7. Limitations of use.
- S. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
- T. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.

- U. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
- V. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

2.2 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file and three paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Division 01 Section "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 - 1. Stamp or statement shall include the following: "The Contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto or will do so, and that he has checked and coordinated the information

contained within such submittals with the requirements of the Work and of the Contract Documents.”

3.2 ARCHITECT'S ACTION

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

END OF SECTION 013300

E.M.G. - ADDITION & RENOVATIONS
ELECTRONIC FILES REQUEST FORM AND WAIVER

NOTE: Electronic files of select documents are being provided to assist bidders who are registered plan holders of complete sets of construction documents only. Requests by others or Plan Rooms will not be filled. The files are for the exclusive use of the requesting bidders only and are not to be copied or transmitted in any form. Printing of documents from the electronic files is specifically prohibited.

REQUEST:

1. Please list the exact drawings that you wish to receive in electronic format. (You must list the specific drawings that you wish to receive, NOT descriptions like “all the electrical drawings”. Limit of 30 drawings)

2. Documents are available in Adobe Acrobat “.PDF” format only. (This form is for requesting documents other than Civil ONLY.) Documents will be burned onto a CD and can be mailed to requester or picked up at PDT Architects.

3. Please list the your, company name, and address as it appears on the list of registered plan holders: _____

4. **Payment:** Please enclose a check payable to PDT Architects in the amount of \$60.00 and enclose it with this form. Requests for documents will not be processed with out completed form and the payment. This is a non-refundable payment for producing and handling the electronic files.

WAIVER:

Receipt and/or use of these files in whole or in part constitutes Recipient’s agreement to the following:

- a) This information is for use on the above referenced project only. Reuse of the data without forwarding a print copy to, and without authorization and/or adaptation by PDT Architects, will be at the sole risk of the user and without liability or legal exposure to PDT Architects, its dependent consultants and professional associates. PDT Architects does not represent that the data is suitable for reuse on the specific project or any other projects. Furthermore, the user shall indemnify and hold harmless PDT Architects, its independent consultants and professional associates from any and all claims, damages, losses and expenses, and including attorney’s fees, through appeal, arising out of or resulting there from.
- b) Copies that can be relied upon for data transferred between the Architect and the receiving party is limited to printed copies only (also known as hard copies). Files delivered in electronic format are only for the convenience of the receiving party. Any conclusion or information derived from such files shall be at the user’s sole risk.

- c) Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic data agrees that it will perform acceptance tests upon receipt, after which the receiving party shall be deemed to have accepted the data. Any errors detected upon receipt shall be corrected by the delivering party. PDT Architects makes no representations to the Recipient or others as to the long-term usability or readability of electronic media or of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the creating party.
- d) Please note that these files are being provided for, and are intended as, an aid in the preparation of bid proposals only. Please be advised that you should exercise due caution in thoroughly reviewing these files against the printed Construction Documents, because these files do not reflect changes made by Addendum. There may also be either a loss of data or error in translating between CAD platforms and programs. In case of discrepancy, the original printed Construction Documents, as modified by Addendum or other clarification, shall always prevail.
- e) If you notice any discrepancies, or have any problems with the files, please notify PDT Architects promptly, so that we may help resolve them.

Accepted by:

Authorized Signature

Printed Name

Company

Date

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.

- D. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.
- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to tradespeople of the corresponding generic name.
- J. Experienced: When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. General: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.5 INFORMATIONAL SUBMITTALS

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

- B. Qualification Data: For Contractor's quality-control personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
 - 1. Specification Section number and title.
 - 2. Description of test and inspection.
 - 3. Identification of applicable standards.
 - 4. Identification of test and inspection methods.
 - 5. Number of tests and inspections required.
 - 6. Time schedule or time span for tests and inspections.
 - 7. Entity responsible for performing tests and inspections.
 - 8. Requirements for obtaining samples.
 - 9. Unique characteristics of each quality-control service.

1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award or Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
 - 1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: Include in quality-control plan a comprehensive schedule of Work requiring testing or inspection, including the following:
 - 1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
 - 2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
 - 3. Owner-performed tests and inspections indicated in the Contract Documents.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into

compliance with standards of workmanship established by Contract requirements and approved mockups.

- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

1.7 REPORTS AND DOCUMENTS

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

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

- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:

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

- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.

3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

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

1.8 QUALITY ASSURANCE

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

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

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

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

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

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

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

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

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

- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. 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.
- K. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
 - 1. Contractor responsibilities include the following:
 - a. Provide test specimens representative of proposed products and construction.
 - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
 - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
 - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
 - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to 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.
- L. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
 - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
 - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at the Project.
 - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
 - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.

- a. Allow seven days for initial review and each re-review of each mockup.
6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
7. Demolish and remove mockups when directed, unless otherwise indicated.

1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated in individual specification sections as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 2. Payment for these services will be made by Owner.
 3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."
- D. Manufacturer's Technical Services: Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and

conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.

- E. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
 - 1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
 - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 - 6. Do not perform any duties of Contractor.
- G. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
 - 1. Access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 - 4. Facilities for storage and field curing of test samples.
 - 5. Delivery of samples to testing agencies.
 - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
 - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

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

1.10 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.
- B. Special Tests and Inspections: Conducted by a qualified special inspector as required by authorities having jurisdiction, as indicated in individual Specification Sections, 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 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

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

3.2 REPAIR AND PROTECTION

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

1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- J. Substantial Completion: The stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so the Owner can occupy or utilize the Work for its intended use. Minor corrections and repairs that can be performed while the Owner has occupied the building and without undue annoyance to personnel will be acceptable under the definition of Substantial Completion. It shall also include major final cleaning required under the Contract, removal of all surplus equipment and material

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

- K. Construction Documents: All of the written and graphic documents prepared or assembled by the Architect/Engineer for communicating the design and administering the project.
- L. Bidding Documents: All of the documents required to bid or negotiate the construction contract. They are the bidding requirements, contract forms, contract conditions, specifications, drawings and addenda.
- M. Contract Documents: Form the legal agreement between the Owner and the Contractor. They include all of the construction documents except the bidding requirements.
- N. Project Manual: Includes the documents that can be easily bound into book format, including the bidding requirements, contract forms, conditions and specifications.

1.3 INDUSTRY STANDARDS

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

1.4 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities indicated in Thomson Gale's "Encyclopedia of Associations" or in Columbia Books' "National Trade & Professional Associations of the U.S."
- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

BOCA BOCA International, Inc.
 (See ICC)

IBC	International Building Code	
ICBO	International Conference of Building Officials (See ICC)	
ICC	International Code Council www.iccsafe.org	(888) 422-7233 (703) 931-4533
NFPA	NFPA (National Fire Protection Association) www.nfpa.org	(800) 344-3555 (617) 770-3000
UBC	Uniform Building Code (See ICC)	

C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167
OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999
USDA	Department of Agriculture www.usda.gov	(202) 720-2791

D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

E. State Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

MDEP State of Maine Department of Environmental Protection

MDOT State of Maine Department of Transportation

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for work restrictions and limitations on utility interruptions.
 - 2. Division 31 Section "Dewatering" for disposal of ground water at Project site.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, testing agencies, and authorities having jurisdiction.
- B. Water Service: 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: 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.
- D. Heating Fuel: Fuel required for temporary heating will be the responsibility of the Contractor.
- E. Telephone Service: Pay service and use charges for telephone or data cable usage, by Contractor, at Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

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

1.5 QUALITY ASSURANCE

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

1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Frost Protection: Protect footings and slabs from freezing temperatures and prevent frost from occurring beneath footings and slabs. Frozen water found on soil or concrete surface shall be

reason for rejection of protection method. Provide corrective measures within 24 hours after notice of condition is given. Evidence of frost at these locations shall be reason for rejection, removal, and replacement at no additional cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

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

2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of construction personnel. 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. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
 - 3. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control. Heaters shall be located outside the building and

combustion gases shall be vented outside the building. Maintain observation of units in operation.

1. Use of gasoline-burning space heaters or salamander-type heating units is prohibited.
 2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
1. Locate facilities to limit site disturbance as specified in Division 01 Section "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
1. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- F. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low

temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

1. Maintain a minimum temperature of 50 deg F in permanently enclosed portions of building for normal construction activities, and 65 deg F for finishing activities and areas where finished Work has been installed.
 - a. Refer to Divisions 02 through 48 for additional temporary heat, ventilation, and humidity requirements for products in those Sections.”
 2. Provide temporary heat to protect all concrete and masonry work during installation as well as other trades needing specific heat requirements to perform and protect their work. See individual specification sections for detailed information.
 3. All concrete slabs on grade, footings and foundations not below the frost line shall be protected from freezing either by heating or protecting with insulation until substantial completion.
- G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing work, isolate the HVAC system in area where work is to be performed in accordance with approved coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area using HEPA-equipped air filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust containment devices.
 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- H. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- I. Electric Power Service: Use of Owner's existing electric power service will be permitted, as long as equipment is maintained in a condition acceptable to Owner.
- J. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

- K. 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.
- L. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install separate telephone lines for each field office.
 - 1. At each telephone, post a list of important telephone numbers.
 - a. Police and fire departments.
 - b. Ambulance service.
 - c. Contractor's home office.
 - d. Contractor's emergency after-hours telephone number.
 - e. Architect's office.
 - f. Engineers' offices.
 - g. Owner's office.
 - h. Principal subcontractors' field and home offices.
 - 2. Provide an answering service on superintendent's telephone.

3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
 - 1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
 - 2. Maintain support facilities until near Substantial Completion. 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 improvements to remain including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- C. Parking: Provide temporary parking areas for construction personnel.
- D. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
 - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
 - 2. Remove snow and ice as required to minimize accumulations.
- E. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.

1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated. Include name of project, and names of Owner, Architect and Contractor.
 2. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in size of 4 by 8 feet and 3/4 inch thickness, unless otherwise indicated. Support on posts or framing of preservative-treated wood or steel.
 3. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
 4. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
 - a. Provide temporary, directional signs for construction personnel and visitors.
 5. Maintain and touchup signs so they are legible at all times.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution" for progress cleaning requirements.
- G. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- H. Existing Stair Usage: Use of Owner's existing stairs will be permitted, as long as stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If, despite such protection, stairs become damaged, restore damaged areas so no evidence remains of correction work.
- 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION
- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
1. Comply with work restrictions specified in Division 01 Section "Summary."
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

1. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Site Enclosure Fence: When excavation begins, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
- G. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Covered Walkway: Erect structurally adequate, protective, covered walkway for passage of individuals along adjacent public street(s). Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction.
 1. Construct covered walkways using scaffold or shoring framing.
 2. Provide wood-plank overhead decking, protective plywood enclosure walls, handrails, barricades, warning signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
 3. Extend back wall beyond the structure to complete enclosure fence.
 4. Paint and maintain in a manner approved by Owner and Architect.
- J. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
 1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.
- K. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
 1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
 2. Construct dustproof partitions with 2 layers of 3-mil polyethylene sheet on each side. Cover floor with 2 layers of 3-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.

- a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches between doors. Maintain water-dampened foot mats in vestibule.
 3. Insulate partitions to provide noise protection to occupied areas.
 4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
 5. Protect air-handling equipment.
 6. Weather strip openings.
 7. Provide walk-off mats at each entrance through temporary partition.
- L. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Prohibit smoking in construction areas.
 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
 3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
 4. Provide hoses for fire protection of sufficient length to reach construction areas. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
 2. Protect stored and installed material from flowing or standing water.
 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 4. Remove standing water from decks.
 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
 2. Keep interior spaces reasonably clean and protected from water damage.
 3. Periodically collect and remove waste containing cellulose or other organic matter.
 4. Discard or replace water-damaged material.
 5. Do not install material that is wet.
 6. Discard, replace or clean stored or installed material that begins to grow mold.

7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 2. Use permanent HVAC system to control humidity.
 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
 2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section "Closeout Procedures."

END OF SECTION 015000

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; product substitutions; and comparable products.
- B. Related Sections include the following:
 - 1. Division 01 Section "Allowances" for products selected under an allowance.
 - 2. Division 01 Section "Alternates" for products selected under an alternate.
 - 3. Division 01 Section "Substitution Procedures" for requests for substitutions.
 - 4. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

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

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
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 appropriate form properly executed.
 3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Where products are accompanied by the term "as selected," Architect will make selection.
 5. Descriptive, performance, and reference standard requirements in the Specifications establish "salient characteristics" of products.
 6. Or Equal: Where products are specified by name and accompanied by the term "or equal" or "or approved equal" or "or approved substitute" or approved," comply with provisions in "Product Substitutions" Article to obtain approval for use of an unnamed product.

B. Product Selection Procedures:

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

C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.

D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

E.M.G. – PHASE 2 – ADDITION & RENOVATION
SITE AND FOUNDATION PACKAGE – JUNE 13, 2013

SECTION 01 70 00.01 – SITE PERMIT REQUIREMENTS

PART 1 - GENERAL

A. Construction of this project must meet the terms and conditions of a City of Portland Level II Site Plan Application approval. Any other permits required to conduct the work shall be obtained by the Contractor.

1. City of Portland Level II Site Plan Review: The Contractor shall be responsible for scheduling a preconstruction conference with the City Planner, the City Engineer, the Owner, and the Owner's representatives at a time that is mutually convenient to the parties.

***** Other conditions to be added upon completion of City of Portland review process.**

END OF SECTION 01 70 00.01

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1. Installation of the Work.
2. Cutting and patching.
3. Coordination of Owner-installed products.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

- B. Related Sections:

1. Division 01 Section "Submittal Procedures" for submitting surveys.
2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.
3. Division 02 Section "Selective Structure Demolition" for demolition and removal of selected portions of the building.
4. Division 07 Section "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.3 DEFINITIONS

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

1.4 WARRANTY

- A. 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.

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 the Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

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

- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Architect according to requirements in Division 01 Section "Project Management and Coordination."

3.3 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
 - 4. Maintain minimum headroom clearance of 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that

adequate provisions are made for locating and installing products to comply with indicated requirements.

- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by 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.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.4 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. Temporary Support: Provide temporary support of work to be cut.
- C. 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.
- D. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements of Division 01 Section "Summary."
- 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 prevent 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 Division 31 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.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- H. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.5 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.

- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces.
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

3.6 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. For general construction, each trade shall pick up the debris and rubbish, generated by that trade, and dispose of in dumpsters furnished by the General Contractor.
- E. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- F. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- G. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- H. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."

- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.7 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.8 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. Comply with manufacturer's written instructions for temperature and relative humidity.
- C. Protect resilient flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
 - 1. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.
 - 2. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.
- D. Protect roofing materials against cuts, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period.

1. Do not move heavy and sharp objects directly over roof surfaces. Place plywood or hardboard panels over roofing and under objects while they are being moved. Slide or roll objects over panels without moving panels.

3.9 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Inspection procedures.
 - 3. Warranties.
 - 4. Final cleaning.
 - 5. Repair of the Work.
- B. Related Sections include the following:
 - 1. Division 01 Section "Execution" for progress cleaning of Project site.
 - 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Division 01 Section "Operation and Maintenance Data" for operation and maintenance manual requirements.
 - 4. Divisions 02 through 48 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.

1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest control inspection.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

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

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
5. Submit test/adjust/balance records.
6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.

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

1. Advise Owner of pending insurance changeover requirements.
2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.

8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements, including touchup painting.
 10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:
1. Submit a final Application for Payment according to Division 01 Section "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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
- C. Re-Inspection Fees:
1. If the Architect Perform Re-inspections Due to Failure of the Work to Comply with the Claims of Status of Completion Made by the Contractor, Or, Should the Contractor fail to complete the work, Or, Should the Contractor fail to promptly correct warranty items or work later found to be deficient:
 - a. Owner will compensate Architect for such additional services.

- b. Owner will deduct the amount of such compensation from the final payment to the Contractor.
2. If the Work is not completed by the date set in the agreement, and the Architect needs to perform additional Contract Administrative and on site observation duties:
 - a. Owner will compensate Architect for such additional services.
 - b. Owner will deduct the amount of such compensation from the final payment to the Contractor.

1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Architect and Construction Manager.
 - d. Name of Contractor.
 - e. Page number.
 4. Architect will submit list of incomplete items in the following format:
 - a. One PDF copy of product schedule or list, unless otherwise indicated.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or

- installation, including the name of the product and the name, address, and telephone number of Installer.
3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
 4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

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: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural

weathering of exterior surfaces. Restore reflective surfaces to their original condition.

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

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

- m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- n. Replace parts subject to unusual operating conditions.
- o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
- q. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter upon inspection.
 - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report upon completion of cleaning.
- r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
- s. Leave Project clean and ready for occupancy.

- C. Construction Waste Disposal: Comply with waste disposal requirements in Division 01 Section "Temporary Facilities and Controls."

3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored,

provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
 - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Emergency manuals.
 - 3. Operation manuals for systems, subsystems, and equipment.
 - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes systems and equipment.
- B. Related Sections include the following:
 - 1. Division 01 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 01 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Division 01 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 02 through 48 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

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

1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.

2. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
1. PDF electronic file. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Architect.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
1. Correct or modify each manual to comply with Architect's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.
 3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to

ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

2.2 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Construction Manager.
 6. Name and contact information for Architect.
 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.

2.3 EMERGENCY MANUALS

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

2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
1. System, subsystem, and equipment descriptions.
 2. Performance and design criteria if Contractor is delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- B. Descriptions: Include the following:

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

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

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

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

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

2.5 PRODUCT MAINTENANCE MANUALS

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

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

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

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

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

1. Inspection procedures.

2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard printed maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training videotape, if available.
- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.

2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

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

1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record Specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up Record Prints.
- B. Record Specifications: Submit one copy of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit one copy of each Product Data submittal.
 - 1. Where Record Product Data is required as part of operation and maintenance manuals, submit marked-up Product Data as an insert in manual instead of submittal as Record Product Data.
- D. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy of each submittal.

PART 2 - PRODUCTS

2.1 RECORD DRAWINGS

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

1. Preparation: Mark Record Prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to prepare the marked-up Record Prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below first floor.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directive.
 - k. Changes made following Architect's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 3. Mark the Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."

- d. Name of Architect and Construction Manager.

2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.
 1. Include record Product Data directory organized by specification section number and title, electronically linked to each item of record Product Data.

2.4 MISCELLANEOUS RECORD SUBMITTALS

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

PART 3 - EXECUTION

3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and modifications to Project Record Documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents and Samples: Store Record Documents and Samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Architect's reference during normal working hours.

END OF SECTION 017839

SECTION 023200 – GEOTECHNICAL INVESTIGATIONS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. Related Documents: Drawings and General Provisions of Contract, including General and Supplementary Conditions apply to work of this Section.

1.2 DESCRIPTION OF WORK

Contractor shall review the geotechnical report and supplement prepared for the project by S. W. Cole of Portland, Maine. This report is appended to this section of Project Manual. During the Bidding Process, the Contractor may conduct his own subsurface investigations after requesting and receiving prior approval from the Owner. The request for approval shall be accompanied by a plan indicating the location and type of investigations to be undertaken by the Contractor. The Contractor is encouraged to verify Owner's subsurface investigations and shall notify the Owner in writing prior to the bid date of any discrepancies.

PART 2 - PRODUCTS

2.1 REPORT

- A. Subsurface conditions have been investigated by test pits, borings, and probes. Locations of the test pits and borings are shown on the contract drawings. Logs of the explorations are also appended to these specifications.
- B. Said subsurface investigations are not warranted to show the actual subsurface conditions except at the location of said test pits or investigations, and at these points are subject to inaccuracies inherent in methods used and to variations in the classification and interpretation of soil layers.

Subsurface information is included only as an aid to the Bidder and it is the obligation of the Bidder to draw his own conclusions of subsurface conditions from his own investigations prior to submitting his proposal. The Contractor agrees, in signing his Contract, that he will make no claims against the Owner or Architect, if in carrying out the work, he finds that the actual conditions encountered in performing the work do not conform to conditions presented, discussed, or anticipated prior to the commencement of work, the Contractor shall notify the Owner immediately of such differences in the conditions.

PART 3 - EXECUTION

3.1 REPORT REVIEW

A copy of the subsurface investigation reports are appended to the project manual and shall be considered part of the Contract Documents.

END OF SECTION 023200

GEOTECHNICAL REPORT AND CORRESPONDENCE PREPARED BY S. W. COLE

~~GEOTECHNICAL REPORT POSTED UNDER SEPARATE COVER~~

A DRAFT GEOTECHNICAL REPORT IS INCLUDED

IN THE FOLLOWING PAGES.

SEE THE REVISED UNDERDRAIN DETAILS,

WITH STONE BEDDING AND UNDERDRAIN, ADD CMP DUCT

BANK, ATTACHED AT THE END OF THIS MANUAL.

REPORT

June 7, 2013
12-0392 S

Geotechnical Engineering Services

Proposed Building Addition and Parking Lot
53 Sewall Street
Portland, Maine

PREPARED FOR:

Eyecare Medical Group, P.A.
Attention: Clement Berry
53 Sewall Street
Portland, Maine 04102

PREPARED BY:

S.W.COLE ENGINEERING, INC.
286 Portland Road
Gray, Maine 04039
207-657-2866



S.W.COLE
ENGINEERING, INC.

- *Geotechnical Engineering*
- *Construction Materials Testing*
- *GeoEnvironmental Services*
- *Ecological Services*

www.swcole.com

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13-0392 S

June 7, 2013

Eyecare Medical Group, P.A.
Attn: Clement Berry
53 Sewall Street
Portland, Maine 04102

Subject: Explorations and Geotechnical Engineering Services
Proposed Building Addition and Parking Lot
53 Sewall Street
Portland, Maine

Dear Mr. Berry:

In accordance with our Proposal, dated May 9, 2013, we have performed subsurface explorations for the subject project in Portland, Maine. This report summarizes our findings and geotechnical recommendations and its contents are subject to the limitations set forth in Attachment A.

1.0 INTRODUCTION

1.1 Scope and Purpose

The purpose of our services was to obtain subsurface information at the site in order to develop geotechnical recommendations relative to foundations and earthwork associated with the proposed construction. Our scope of services included the making of five test boring explorations, soils laboratory testing, a geotechnical analysis of the subsurface findings and preparation of this report.

1.2 Proposed Construction

The site is located at your existing facility on Sewall Street in Portland, Maine. Based on information provided by PDT Architects (project architect), we understand development plans call for construction of an approximate 45-foot by 125-foot addition off the west side of the existing building and a 20-space parking lot in the southwest corner of the site. We understand the building addition will be one-story with foundations and columns sized for a future second story addition.

Based on information provided by Becker Structural Engineers (project structural engineer), we understand column loads will approach ___-kips, wall loads ___-kips/lf and floor loads ___ psf. Based on foundation plans for the original building, we understand the existing building is supported on spread footing foundations with on-grade floor slabs. We understand the proposed finished floor elevation will match the existing building at elevation 37.5 feet (project datum).

2.0 EXPLORATION AND TESTING

2.1 Explorations

Five test borings (B-101 through B-105) were made at the site on May 24, 2013 by Northern Test Boring, Inc. of Gorham, Maine working under subcontract to S.W. COLE ENGINEERING, INC. (SWCE). The boring locations were selected and established in the field by SWCE using taped measurements from existing site features. The approximate exploration locations are shown on the "Exploration Location Plan" attached as Sheet 1. Logs of the explorations are attached as Sheets 2 through 7. A key to the notes and symbols used on the logs is attached as Sheet 8.

2.2 Testing

The borings were performed using a combination of solid stem auger, cased wash-boring and rod probing techniques. The soils were sampled at 2 to 5 foot samples using Standard Penetration Testing (SPT) techniques. Shelby tube sampling and in-situ Vane Shear Testing (VST) was performed in softer silty clay soils. SPT blow counts and VST results are shown on the logs.

Soil samples obtained from the explorations were returned to our laboratory for further classification and testing. Atterberg Limits and moisture content test results are noted on the logs. The results of a one-dimensional laboratory consolidation test are attached as Sheet 9.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 Surficial Conditions

The site is currently developed with a single-story medical office building and associated paved areas. The site is relatively flat and level. The proposed building addition is

situated over existing paved and landscape area. The proposed parking area is situated over a undeveloped wooded area. Proposed and existing site features are shown on the "Exploration Location Plan" attached as Sheet 1.

3.2 Subsurface Conditions

Test borings B-101 and B-102 were made in the area of the proposed building addition. These test borings encountered a subsurface profile generally consisting of approximately 3 inches of asphalt pavement overlying 2 to 3 feet of compacted granular fill overlying 11 to 13 feet of hard to stiff brown silty clay overlying 8 to 20 feet of medium to soft gray silty clay overlying sand and gravel overlying refusal surfaces (probable bedrock) at depths of 34 to 36 feet below the ground surface. The gray silty clay is soft and compressible with approximately ___ psf of over-consolidation. Vane shear testing performed in the softer gray silty clay indicates undrained shear strengths on the order of 590 to 890 psf.

Test boring B-103 was made in an area of a future building addition contemplated as an elevated single story building with on-grade parking below connecting to the proposed west building addition. This test boring encountered a subsurface profile similar to B-101 and B-102 and was terminated on a refusal surface (probable bedrock) at a depth of about 45 feet.

Test borings B-104 and B-105 were made in the area of proposed parking. These test borings encountered dramatically different subsurface conditions. B-104 encountered 4 feet of fill overlying native stiff brown silty clay; whereas B-105 encountered 15 feet of fill with ash, clinker and brick overlying relic bay mud.

Refer to the attached logs for more detailed descriptions of the subsurface findings.

3.3 Groundwater Conditions

The soils were generally wet at depths of 2 to 3 feet. Infiltrated precipitation likely becomes perched on the relatively impervious native clay encountered at the test borings. Long term groundwater information is not available. It should be anticipated that seasonal groundwater levels will fluctuate, especially during periods of snowmelt and precipitation. Groundwater may be tidally influenced considering the proximity of the Fore River Bay.

3.4 Seismic and Frost Considerations

The 25-year Air Freezing Index for the Portland, Maine area is about 1,290-Fahrenheit degree-days, which corresponds to a frost penetration depth on the order of 4.5 feet. Based on the findings at the explorations, we interpret the site soils to correspond to Seismic Soil Site Class D according to 2009 IBC.

4.0 EVALUATION AND RECOMMENDATIONS

4.1 General Findings

Based on the subsurface findings, the proposed construction appears feasible from a geotechnical standpoint. The principle geotechnical considerations are as follows:

- **Proposed Building Addition:** Spread footing foundations and a slab-on-grade floors bearing on properly prepared subgrades appear suitable for the proposed building addition. All existing pavement, structures, utilities, fill and loose, disturbed soils must be completely removed beneath the proposed building addition footprint. Footings should bear on at least 9-inches of compacted Crushed Stone wrapped in geotextile fabric overlying undisturbed native soils.
- **Future Building Addition with On-Grade Parking Below:** Test boring B-103, made for the future building addition, encountered a layer of silty sand with organics extending to a depth of about 5 feet below the ground surface. Footings for the future addition will need to penetrate this layer of soil and bear on undisturbed native hard brown silty clay. Additionally, the existing pavement, gravel and silty sand with organics may need to be removed and replaced with non-frost susceptible sand and gravel in order to mitigate frost action that could adversely affect low-overhead clearance for on-grade parking below the future building addition.
- **Proposed Parking Area:** The test borings made in the area of the proposed parking area encountered 4 to 15 feet of uncontrolled fill. The fill composition varied and contained ash, cinders and brick and may be environmentally impacted with premium handling and disposal costs. The existing fills may also require some overexcavation and replacement in order to support pavement loads.

4.2 Site and Subgrade Preparation

We recommend that site preparation begin with the construction of an erosion control system to protect adjacent drainage ways and areas outside the construction limits. As much vegetation as possible should remain outside the construction areas to lessen the potential for erosion and site disturbance.

We recommend that excavation to subgrade be completed with a smooth-edged bucket to help lessen disturbance of bearing soils. We recommend at least 9 inches of compacted Crushed Stone be provided below all footings. The Crushed Stone should be fully enveloped in non-woven geotextile, such as Mirafi 160N or equivalent.

All existing pavement, structures, utilities, disturbed soils and fills must be completely removed beneath the proposed building addition footprint until undisturbed native hard to very stiff brown silty clay soils are encountered. Overexcavation of unsuitable material should extend 1-foot laterally outward from edge of perimeter footings for every 1-foot of vertical excavation depth (1H:1V bearing splay). Excavations must not undermine existing foundations. Overexcavations should be backfilled to footing subgrade elevation with additional thickness of geotextile wrapped Crushed Stone or to slab-on-grade subgrade elevation with compacted Structural Fill.

4.3 Excavation and Dewatering

Excavation work will generally encounter pavement, sandy and clayey fill materials, and native silty clays. Care must be exercised during construction to minimize disturbance of the bearing soils. Final cuts to subgrade elevation should be performed with a smooth-edged bucket to help minimize soil disturbance.

Sumping and pumping dewatering techniques should be adequate to control groundwater in excavations. Controlling the water levels to at least one foot below planned excavation depths will help stabilize subgrades during construction.

Excavations must be properly shored and/or sloped to prevent sloughing and caving of the sidewalls during construction. Temporary, unsupported soil excavations should be sloped in accordance with the OSHA trenching regulations. Care must be taken to preclude undermining adjacent structures and utilities.

4.4 Foundations

We recommend the proposed building additions be supported on spread footings founded on at least 9-inches of crushed stone wrapped in geotextile fabric bearing on hard to very stiff, undisturbed native brown silty clay.

For foundations bearing on properly prepared subgrades, we recommend the following geotechnical parameters for design consideration:

- Design Frost Depth = 4.5 feet
- Allowable Soil Bearing Pressure = 3.0 ksf or less
- Seismic Soil Site Class = D (IBC 2009)
- Base Friction Factor = 0.40
- Total Unit Weight of Backfill = 130 pcf (compacted Structural Fill)
- Passive Lateral Earth Pressure Coefficient = 3.0 (compacted Structural Fill)
- At-Rest Lateral Earth Pressure Coefficient = 0.5 (compacted Structural Fill)
- Internal Friction Angle of Backfill = 30° (compacted Structural Fill)

Based on structural loading information, laboratory consolidation testing and anticipated grades, we estimate ___-inch or less of total post-construction settlement with differential settlement approaching ___-inch or less.

4.5 Foundation Drainage

We recommend an underdrain system be installed within the 9-inches of Crushed Stone wrapped in geotextile filter fabric recommended below the perimeter spread footings. The underdrain pipe should consist of 4-inch diameter, perforated SDR-35 foundation drain pipe enveloped in 9-inches of Crushed Stone wrapped in filter fabric, such as Mirafi 160N. The underdrain pipe must be connected to a positive gravity outlet protected from freezing, clogging and backflow.

Exterior foundation backfill should be sealed with a surficial layer of clayey or loamy soil in areas that are not paved or occupied by entrance slabs. This is to reduce direct surface water infiltration into the backfill. Surface grades should be sloped away from the building for positive surface water drainage. General underdrain details are provided on Sheet 10.

4.6 Slab-On-Grade

On-grade floor slabs in heated areas may be designed using a subgrade reaction modulus of 150 pci (pounds per cubic inch) provided the slab is underlain by at least 12-inches of compacted Structural Fill placed over properly prepared subgrades. The structural engineer or concrete consultant must design steel reinforcing and joint spacing appropriate to slab thickness and function.

We recommend a sub-slab vapor retarder particularly in areas of the building where the concrete slab will be covered with an impermeable surface treatment or floor covering that may be sensitive to moisture vapors. The vapor retarder must have a permeance that is less than the floor cover or surface treatment that is applied to the slab. The vapor retarder must have sufficient durability to withstand direct contact with the sub-slab base material and construction activity. The vapor retarder material shall be placed according to the manufacturer's recommended method, including the taping and lapping of all joints and wall connections. The architect and/or flooring consultant should select the vapor retarder products compatible with flooring and adhesive materials.

The floor slab should be appropriately cured using moisture retention methods after casting. Typical floor slab curing methods should be used for at least 7 days. The architect or flooring consultant should assign curing methods consistent with current applicable American Concrete Institute (ACI) procedures with consideration of curing method compatibility to proposed surface treatments, flooring and adhesive materials.

4.7 Entrance Slabs and Sidewalks

Entrance slabs and sidewalks adjacent to buildings must be designed to reduce the effects of differential frost action between adjacent pavement, doorways, and entrances. We recommend that clean, non-frost susceptible Structural Fill be provided to a depth of at least 4.5 feet below the top of entrance slabs. This thickness of Structural Fill should extend the full width of the entrance slabs and outward at least 4.5 feet, thereafter transitioning up to the bottom of the adjacent sidewalk or pavement subbase gravel at a 3H:1V or flatter slope. General details of this frost transition zone are attached as Sheet 10.

4.8 Backfill and Compaction

The on-site soils are unsuitable for use in building and paved areas, but may be reused in landscape areas. For building and paved areas, we recommend the following fill and backfill materials:

Structural Fill: Fill to raise site grades and backfill for foundations should be clean, non-frost susceptible sand and gravel meeting the gradation requirements for Structural Fill as given below.

Structural Fill	
Sieve Size	Percent Finer by Weight
4 inch	100
3 inch	90 to 100
¼ inch	25 to 90
#40	0 to 30
#200	0 to 5

Structural Fill is recommended for use as:

- Fill and backfill to raise grades in building areas
- Backfill for overexcavations
- Backfill against foundations
- Backfill within frost transition zones below entrances and sidewalks
- Minimum 12-inch thick layer below slab-on-grade

Crushed Stone: Crushed Stone, used beneath foundations and for underdrain aggregate, should meet the gradation requirements of MDOT Standard Specifications 703.22 "Underdrain Backfill Type C".

Placement and Compaction: Fill should be placed in horizontal lifts and compacted such that the desired density is achieved throughout the lift thickness with 3 to 5 passes of the compaction equipment. Loose lift thicknesses for grading, fill and backfill activities should not exceed 12 inches. We recommend that fill and backfill in building areas be compacted to at least 95 percent of its maximum dry density as determined by ASTM D-1557. Crushed Stone should be compacted with 3 to 5 passes of a vibratory plate compactor having a static weight of at least 500 pounds.

4.9 Weather Considerations

Construction activity should be limited during wet weather and the site soils may require drying before construction activities may continue. The contractor should anticipate the need for water to temper fills in order to facilitate compaction during dry weather. If construction takes place during cold weather, subgrades, foundations and floor slabs must be protected during freezing conditions. Concrete and fill must not be placed on frozen soil; and once placed, the concrete and soil beneath the structure must be protected from freezing.

4.10 Design Review and Construction Testing

S.W.COLE ENGINEERING, INC. should be retained to review the final design and specifications to determine that our earthwork and foundation recommendations have been properly interpreted and implemented.

A soils and concrete testing program should also be implemented during construction to observe compliance with the design concepts, plans, and specifications. S.W.COLE ENGINEERING, INC. is available to provide subgrade observations for foundations as well as testing services for soils, concrete, asphalt, steel and spray-applied fireproofing construction materials.

5.0 CLOSURE

It has been a pleasure to be of assistance to you with this phase of your project. We look forward to working with you during the construction phase of the project.

Sincerely,

S.W.COLE ENGINEERING, INC.

Timothy J. Boyce, P.E.
Senior Geotechnical Engineer

TJB:pfk

Attachment A Limitations

This report has been prepared for the exclusive use of Eyecare Medical Group, P.A. for specific application to the proposed Building Addition and Parking Lot at 53 Sewall Street, Portland, Maine. S.W.COLE ENGINEERING, INC. has endeavored to conduct the work in accordance with generally accepted soil and foundation engineering practices. No warranty, expressed or implied, is made.

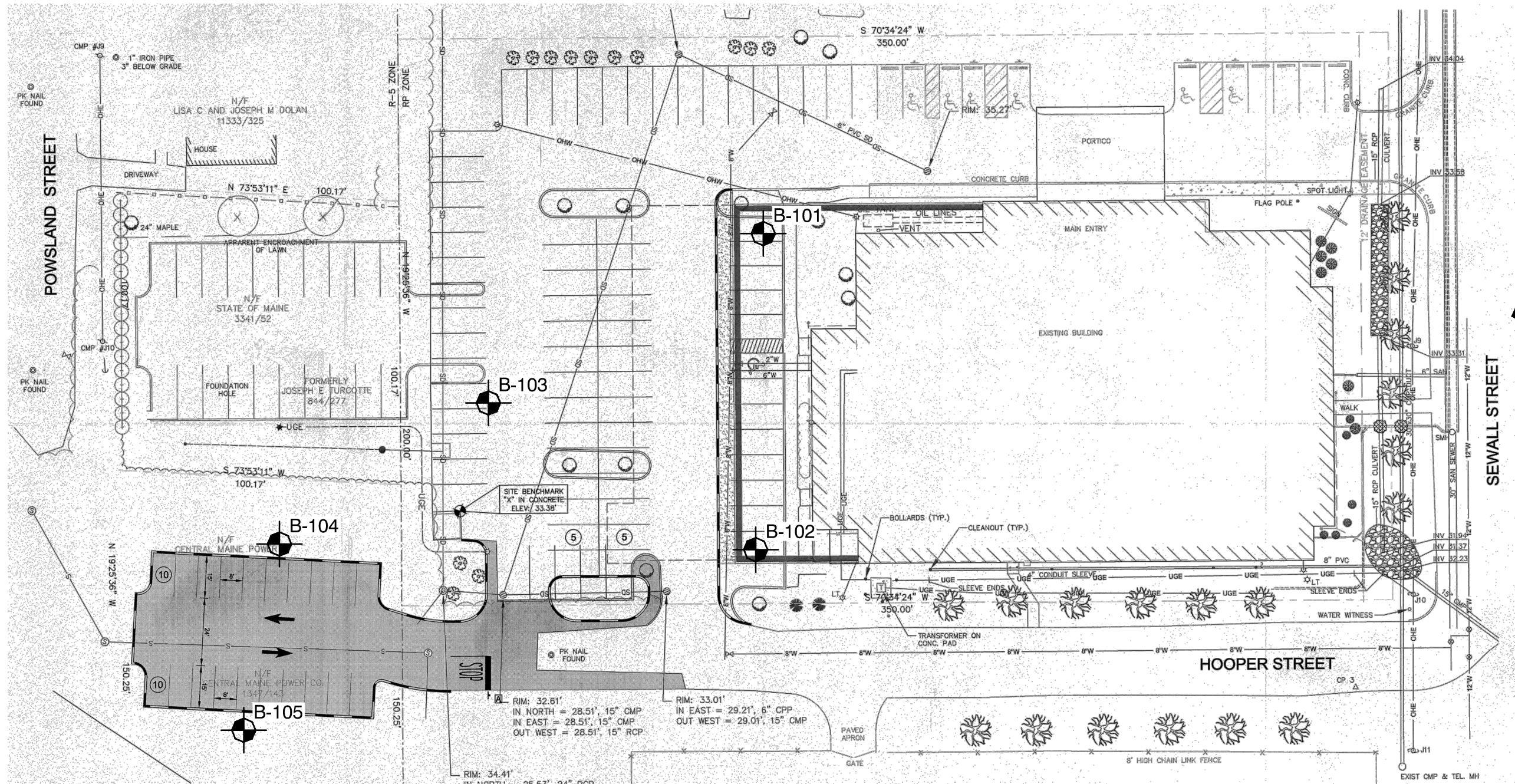
The soil profiles described in the report are intended to convey general trends in subsurface conditions. The boundaries between strata are approximate and are based upon interpretation of exploration data and samples.

The analyses performed during this investigation and recommendations presented in this report are based in part upon the data obtained from subsurface explorations made at the site. Variations in subsurface conditions may occur between explorations and may not become evident until construction. If variations in subsurface conditions become evident after submission of this report, it will be necessary to evaluate their nature and to review the recommendations of this report.

Observations have been made during exploration work to assess site groundwater levels. Fluctuations in water levels will occur due to variations in rainfall, temperature, and other factors.

S.W.COLE ENGINEERING, INC.'s scope of work has not included the investigation, detection, or prevention of any Biological Pollutants at the project site or in any existing or proposed structure at the site. The term "Biological Pollutants" includes, but is not limited to, molds, fungi, spores, bacteria, and viruses, and the byproducts of any such biological organisms.

Recommendations contained in this report are based substantially upon information provided by others regarding the proposed project. In the event that any changes are made in the design, nature, or location of the proposed project, S.W.COLE ENGINEERING, INC. should review such changes as they relate to analyses associated with this report. Recommendations contained in this report shall not be considered valid unless the changes are reviewed by S.W.COLE ENGINEERING, INC.



LEGEND:



APPROXIMATE BORING LOCATION

NOTES:

1. EXPLORATION LOCATION PLAN WAS PREPARED FROM A 1"=20' SCALE PLAN OF THE SITE ENTITLED "SITE LAYOUT PLAN," PREPARED BY DELUCA-HOFFMAN ASSOCIATES, INC., DATED MAY 2013, AND PROVIDED AS A PORTABLE DOCUMENT FORMAT (PDF).
2. THE BORINGS WERE LOCATED IN THE FIELD BY TAPED MEASUREMENTS FROM EXISTING SITE FEATURES.

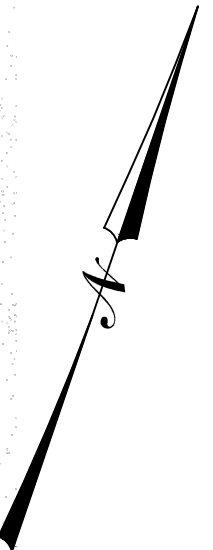
3. THIS PLAN SHOULD BE USED IN CONJUNCTION WITH THE ASSOCIATED S.W. COLE ENGINEERING, INC. GEOTECHNICAL REPORT.
4. THE PURPOSE OF THIS PLAN IS ONLY TO DEPICT THE LOCATION OF THE EXPLORATIONS IN RELATION TO THE EXISTING CONDITIONS AND PROPOSED CONSTRUCTION AND IS NOT TO BE USED FOR CONSTRUCTION.



EYE CARE MEDICAL GROUP

EXPLORATION LOCATION PLAN
 PROPOSED BUILDING ADDITION AND PARKING LOT
 53 SEWALL STREET
 PORTLAND, MAINE

Job No.: 13-0392 Scale: 1" = 40'
 Date: 06/03/2013 Sheet: 1





BORING LOG

BORING NO.: **B-101**
 SHEET: OF
 PROJECT NO.: 13-0392
 DATE START: 5/24/2013
 DATE FINISH: 5/24/2013
 ELEVATION: NOT AVAILABLE
 SWC REP.: PJO

PROJECT / CLIENT: PROPOSED BUILDING ADDITION AND PARKING LOT / EYE CARE MEDICAL GROUP
 LOCATION: 53 SEWALL STREET / PORTLAND MAINE
 DRILLING CO.: NORTHERN TEST BORINGS, INC. DRILLER: MIKE NADEAU

	TYPE	SIZE I.D.	HAMMER WT.	HAMMER FALL
CASING:	SSA/HW	4"	140 LBS.	30"
SAMPLER:	SS	1 3/8"	140 LBS.	30"
CORE BARREL:				

WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
	1D	24"	10"	2.3'	5	4	4	3	3.0'	3 1/2" ASPHALT BROWN GRAVELLY SAND SOME SILT (FILL) ~LOOSE~
	2D	24"	22"	7.0'	3	6	7	6	14.0'	BROWN MOTTLED DARK BROWN SILTY CLAY w = 29.3% $q_p = 8.0-9.0$ KSF ~HARD BECOMING... WITH OCCASIONAL FINE SAND SEAMS ...STIFF~ $q_p = 5.0$ KSF w = 36.0% $q_p = 3.0$ KSF
	3D	24"	22"	12.0'	3	4	3	4		
	1V	3.5 X 7" VANE	15.6'							34.7'
	1V	3.5 X 7" VANE	16.2'							
	1S	24"	18"	22.0'	HYDRAULIC PUSH					
	2V	3.5 X 7" VANE	22.6'							
	2V	3.5 X 7" VANE	23.2'							
	3V	3.5 X 7" VANE	25.6'							
									35.9'	ADVANCED BY ROD PROBE 70 BLOWS FOR 15" PROBABLE SAND AND GRAVEL
										REFUSAL AT 35.9' (PROBABLE BEDROCK)

SAMPLES:
 D = SPLIT SPOON
 C = 2" SHELBY TUBE
 S = 3" SHELBY TUBE
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:

<input type="checkbox"/>	DRILLER - VISUALLY
<input checked="" type="checkbox"/>	SOIL TECH. - VISUALLY
<input checked="" type="checkbox"/>	LABORATORY TEST

REMARKS:
 STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

(2)

BORING NO.: **B-101**



BORING LOG

BORING NO.: **B-102**
 SHEET: 1 OF 1
 PROJECT NO.: 13-0392
 DATE START: 5/24/2013
 DATE FINISH: 5/24/2013
 ELEVATION: NOT AVAILABLE
 SWC REP.: PJO

PROJECT / CLIENT: PROPOSED BUILDING ADDITION AND PARKING LOT / EYE CARE MEDICAL GROUP
 LOCATION: 53 SEWALL STREET / PORTLAND MAINE
 DRILLING CO.: NORTHERN TEST BORINGS, INC. DRILLER: MIKE NADEAU

	TYPE	SIZE I.D.	HAMMER WT.	HAMMER FALL
CASING:	SSA / HW	4"	140 LBS.	30"
SAMPLER:	SS	1 3/8"	140 LBS.	30"
CORE BARREL:				

WATER LEVEL INFORMATION

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA	
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24			
									2.1'	2 3/4" ASPHALT BROWN GRAVELLY SILTY SAND WITH CLAY LAYERS BELOW 1.7'	
	1D	24"	14"	2.3'	6	6	5	4			
	2D	24"	12"	4.3'	3	5	6	8		~HARD BECOMING... q _p = 8.0 KSF	
	3D	24"	22"	7.0'	4	5	7	8		BROWN MOTTLED SILTY CLAY q _p = 9.0 KSF WITH OCCASIONAL GRAY SILT SEAMS	
	4D	24"	15"	9.0'	5	6	9	8		q _p = 8.5 KSF	
	5D	24"	24"	12.0'	3	4	4	5		...STIFF~ q _p = 4.0 KSF q _p = 3.0 KSF	
									15.0'		
	1V	2.5 X 5" VANE		15.4'					15.8'	S _v = 1.12 KSF / 0.11 KSF GRAYISH-BROWN SILTY CLAY	
	1V'	2.5 X 5" VANE		15.8'						S _v = 0.90 KSF / 0.08 KSF ~STIFF TO MEDIUM~	
	6D	24"	20"	17.8'	HYDRAULIC PUSH						
	1S	24"	20"	20.0'	HYDRAULIC PUSH						
	2V	3.5 X 7" VANE		20.6'						S _v = 0.83 KSF / 0.13 KSF	
	2V'	3.5 X 7" VANE		21.2'						S _v = 0.89 KSF / 0.15 KSF	
									23.5'		
	7D	24"	15"	26.0'	24	32	24	23		BROWN SAND AND GRAVEL SOME SILT ~VERY DENSE~ ADVANCED BY ROLLER CONE FROM 26' TO 34'	
									34.0'		
										REFUSAL AT 34.0' (PROBABLE BEDROCK)	

SAMPLES: D = SPLIT SPOON
 C = 2" SHELBY TUBE
 S = 3" SHELBY TUBE
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:

	DRILLER - VISUALLY
X	SOIL TECH. - VISUALLY
	LABORATORY TEST

REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

3

BORING NO.: **B-102**



BORING LOG

BORING NO.: **B-103**
 SHEET: 1 OF 2
 PROJECT NO.: 13-0392
 DATE START: 5/24/2013
 DATE FINISH: 5/24/2013
 ELEVATION: NOT AVAILABLE
 SWC REP.: PJO

PROJECT / CLIENT: PROPOSED BUILDING ADDITION AND PARKING LOT / EYE CARE MEDICAL GROUP
 LOCATION: 53 SEWALL STREET / PORTLAND MAINE
 DRILLING CO.: NORTHERN TEST BORINGS, INC. DRILLER: MIKE NADEAU

	TYPE	SIZE I.D.	HAMMER WT.	HAMMER FALL
CASING:	SSA / HW	4"	140 LBS.	30"
SAMPLER:	SS	1 3/8"	140 LBS.	30"
CORE BARREL:				

WATER LEVEL INFORMATION
 SOILS WET AT 2.2 FEET

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
									2.2'	2 1/2" ASPHALT BROWN GRAVELLY SAND SOME SILT (FILL) ~MEDIUM DENSE~
	1D	24"	12"	2.2'	5	9	10	9	5.0'	GRAYISH-BROWN SILTY SAND WITH ORGANIC SILT AND DARK GRAY CLAY LAYERS (DISTURBED) ~LOOSE~
	2D	24"	16"	4.2'	5	2	3	2		
	3D	24"	20"	7.0'	3	3	4	4	7.0'	GRAYISH-BROWN SILTY CLAY WITH FREQUENT FINE SAND SEAMS ~VERY STIFF~ $q_p = 7.0$ KSF
	4D	24"	14"	9.0'	3	5	7	7	14.5'	BROWN MOTTLED DARK BROWN SILTY CLAY $q_p = 8.0$ KSF ~HARD BECOMING... ...STIFF~ $q_p = 7.0$ KSF
	5D	24"	22"	12.0'	4	5	6	8		
	6D	24"	24"	17.0'	2	2	2	2		
	1V	3.5 X 7" VANE	20.6'							$S_v = 0.75$ KSF / 0.13 KSF ~MEDIUM~ $S_v = 0.67$ KSF / 0.12 KSF
	1V'	3.5 X 7" VANE	21.2'							
	2V	3.5 X 7" VANE	25.6'							$S_v = 0.68$ KSF / 0.13 KSF $S_v = 0.78$ KSF / 0.13 KSF
	2V'	3.5 X 7" VANE	26.2'							
										HYDRAULIC PUSH ROD PROBE 26.2' TO 43.4'

SAMPLES:
 D = SPLIT SPOON
 C = 2" SHELBY TUBE
 S = 3" SHELBY TUBE
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
 DRILLER - VISUALLY
 SOIL TECH. - VISUALLY
 LABORATORY TEST

REMARKS:
 STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.

4

BORING NO.: **B-103**



BORING LOG

BORING NO.: **B-104**
 SHEET: 1 OF 1
 PROJECT NO.: 13-0392
 DATE START: 5/24/2013
 DATE FINISH: 5/24/2013
 ELEVATION: NOT AVAILABLE
 SWC REP.: PJO

PROJECT / CLIENT: PROPOSED BUILDING ADDITION AND PARKING LOT / EYE CARE MEDICAL GROUP
 LOCATION: 53 SEWALL STREET / PORTLAND MAINE
 DRILLING CO.: NORTHERN TEST BORINGS, INC. DRILLER: MIKE NADEAU

	TYPE	SIZE I.D.	HAMMER WT.	HAMMER FALL
CASING:	SSA	4" O.D.	140 LBS.	30"
SAMPLER:	SS	1 3/8"	140 LBS.	30"
CORE BARREL:				

WATER LEVEL INFORMATION
 FILL SOILS WET AT 2.0 FEET

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
	1D	24"	18"	2.0'	2	3	3	4	4.0'	GRAYISH-BROWN CLAYEY SANDY SILT WITH ORGANICS (REWORKED FILL) ~LOOSE~
	2D	24"	12"	4.0'	4	3	2	2		
	3D	24"	18"	6.0'	6	5	6	7	6.0'	BROWN MOTTLED DARK BROWN SILTY CLAY ~VERY STIFF~ q _p = 6.0 KSF
										BOTTOM OF EXPLORATION AT 6.0'

SAMPLES:
 D = SPLIT SPOON
 C = 2" SHELBY TUBE
 S = 3" SHELBY TUBE
 U = 3.5" SHELBY TUBE

SOIL CLASSIFIED BY:
 DRILLER - VISUALLY
 SOIL TECH. - VISUALLY
 LABORATORY TEST

REMARKS:
 STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.



BORING LOG

BORING NO.: **B-105**
 SHEET: 1 OF 1
 PROJECT NO.: 13-0392
 DATE START: 5/24/2013
 DATE FINISH: 5/24/2013
 ELEVATION: NOT AVAILABLE
 SWC REP.: PJO
 WATER LEVEL INFORMATION
 FILL SOILS WET AT 2 FEET

PROJECT / CLIENT: PROPOSED BUILDING ADDITION AND PARKING LOT / EYE CARE MEDICAL GROUP
 LOCATION: 53 SEWALL STREET / PORTLAND MAINE
 DRILLING CO.: NORTHERN TEST BORINGS, INC. DRILLER: MIKE NADEAU

	TYPE	SIZE I.D.	HAMMER WT.	HAMMER FALL
CASING:	SSA	4" O.D.	140 LBS.	30"
SAMPLER:	SS	1 3/8"	140 LBS.	30"
CORE BARREL:				

CASING BLOWS PER FOOT	SAMPLE				SAMPLER BLOWS PER 6"				DEPTH	STRATA & TEST DATA
	NO.	PEN.	REC.	DEPTH @ BOT	0-6	6-12	12-18	18-24		
	1D	24"	15"	2.0'	2	2	3	4	4.0'	BROWN SAND AND SILT SOME GRAVEL WITH TRACE AMOUNTS OF CLINKER, CHARCOAL, BRICK AND ASH (FILL) ~LOOSE~
	2D	24"	14"	4.0'	5	5	5	5		
	3D	24"	15"	7.0'	3	4	6	3	15.0'	GRAY-BROWN CLAYEY SILT TRACE GRAVEL WITH ORGANICS (FILL) ~LOOSE~ ~LOOSE~ PUSHING PIECE OF GRAVEL
	4D	24"	7"	12.0'	4	4	5	5		
	5D	5"	5"	12.4'	35/5"					
	6D	24"	20"	17.0'	4	4	5	5	16.4'	BROWN MEDIUM TO COARSE SAND ~LOOSE~
									17.0'	GRAY SANDY SILT SOME CLAY WITH ORGANICS (BAY DEPOSIT)
										BOTTOM OF EXPLORATION AT 17.0'

SAMPLES: D = SPLIT SPOON C = 2" SHELBY TUBE S = 3" SHELBY TUBE U = 3.5" SHELBY TUBE	SOIL CLASSIFIED BY: <input type="checkbox"/> DRILLER - VISUALLY <input checked="" type="checkbox"/> SOIL TECH. - VISUALLY <input type="checkbox"/> LABORATORY TEST	REMARKS: STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY BETWEEN SOIL TYPES AND THE TRANSITION MAY BE GRADUAL.	<div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center; margin: 0 auto;">7</div>
			BORING NO.: B-105



KEY TO THE NOTES & SYMBOLS

Test Boring and Test Pit Explorations

All stratification lines represent the approximate boundary between soil types and the transition may be gradual.

Key to Symbols Used:

w	-	water content, percent (dry weight basis)
q _u	-	unconfined compressive strength, kips/sq. ft. - based on laboratory unconfined compressive test
S _v	-	field vane shear strength, kips/sq. ft.
L _v	-	lab vane shear strength, kips/sq. ft.
q _p	-	unconfined compressive strength, kips/sq. ft. based on pocket penetrometer test
O	-	organic content, percent (dry weight basis)
W _L	-	liquid limit - Atterberg test
W _P	-	plastic limit - Atterberg test
WOH	-	advance by weight of hammer
WOM	-	advance by weight of man
WOR	-	advance by weight of rods
HYD	-	advance by force of hydraulic piston on drill
RQD	-	Rock Quality Designator - an index of the quality of a rock mass. RQD is computed from recovered core samples.
γ _T	-	total soil weight
γ _B	-	buoyant soil weight

Description of Proportions:

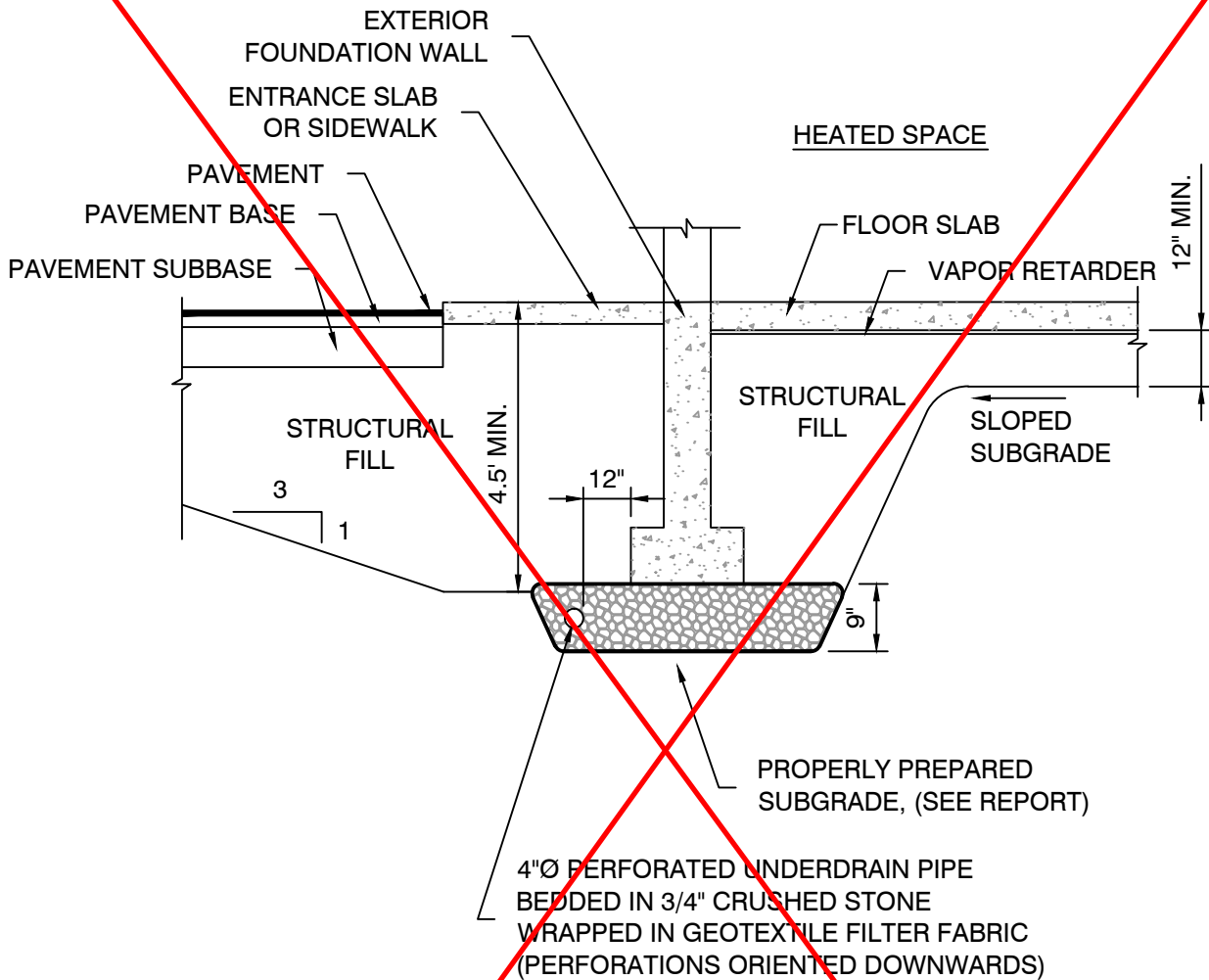
0 to 5% TRACE
5 to 12% SOME
12 to 35% "Y"
35+% AND

REFUSAL: Test Boring Explorations - Refusal depth indicates that depth at which, in the drill foreman's opinion, sufficient resistance to the advance of the casing, auger, probe rod or sampler was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

REFUSAL: Test Pit Explorations - Refusal depth indicates that depth at which sufficient resistance to the advance of the backhoe bucket was encountered to render further advance impossible or impracticable by the procedures and equipment being used.

Although refusal may indicate the encountering of the bedrock surface, it may indicate the striking of large cobbles, boulders, very dense or cemented soil, or other buried natural or man-made objects or it may indicate the encountering of a harder zone after penetrating a considerable depth through a weathered or disintegrated zone of the bedrock.

SEE 6/12/2013 REVISION



NOTE:

1. UNDERDRAIN INSTALLATION AND MATERIAL GRADATION RECOMMENDATIONS ARE CONTAINED WITHIN THIS REPORT.
2. DETAIL IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONSTRUCTION.



EYE CARE MEDICAL GROUP
UNDERDRAIN DETAIL

PROPOSED BUILDING ADDITION AND PARKING LOT
53 SEWALL STREET
PORTLAND, MAINE

Job No.:	13-0392	Scale:	Not to Scale
Date :	06/07/2013	Sheet:	10

SECTION 024119 - SELECTIVE STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of selected portions of building or structure.
 - 2. Demolition and removal of selected site elements.
 - 3. Salvage of existing items to be reused or recycled.
- B. Related Sections include the following:
 - 1. Division 01 Section "Summary" for use of premises, and phasing, and Owner-occupancy requirements.
 - 2. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
 - 3. Division 01 Section "Execution" for cutting and patching procedures.

1.3 DEFINITIONS

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

1.4 QUALITY ASSURANCE

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

1.5 PROJECT CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
 - 1. Comply with requirements specified in Division 01 Section "Summary."
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - 1. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Owner will remove hazardous materials under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
 - 1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes or templates.
 - 1. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.
- G. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
 - 1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."
- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
 - 1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
 - 3. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
 - 4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
 - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."

- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
 4. Cover and protect furniture, furnishings, and equipment that have not been removed.
 5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Division 01 Section "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
 5. Maintain adequate ventilation when using cutting torches.
 6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 8. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:

1. Clean salvaged items.
2. Pack or crate items after cleaning. Identify contents of containers.
3. Store items in a secure area until delivery to Owner.
4. Transport items to Owner's storage area on-site.
5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.
1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.
- F. Roofing: Remove no more existing roofing than can be covered in one day by new roofing and so that building interior remains watertight and weathertight. Refer to Division 07 Sections for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
 2. Remove existing roofing system down to substrate.

- G. Air-Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

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

3.7 CLEANING

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

END OF SECTION 024119

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, and finishes, mud slabs, Flowable fill and under slab vapor barrier system.
- B. Related Sections include the following:
 - 1. Division 2 Section "Earthwork" for drainage fill under slabs-on-grade.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 REFERENCES

- A. American Concrete Institute (ACI):
 - 1. 117 - Specifications for Tolerances for Concrete Construction and Materials
 - 2. 301 - Specifications for Structural Concrete for Buildings
 - 3. 305R - Hot Weather Concreting
 - 4. 306R - Cold Weather Concreting
 - 5. 309R - Guide for Consolidation of Concrete
 - 6. 315 - Manual of Standard Practice for Detailing Reinforced Concrete
 - 7. 347 - Recommended Practice for Concrete Formwork
 - 8. 318 - Building Code Requirements for Reinforced Concrete
 - 9. 544.1R - State-of-the-Art Report of Fiber Reinforced Concrete
 - 10. 554.2R - Measurement of Properties of Fiber Reinforced Concrete
- B. American Society for Testing and Materials (ASTM):
 - 1. A 185 - Welded Steel Wire Fabric for Concrete Reinforcement
 - 2. A 615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 3. C 33 - Concrete Aggregate
 - 4. C 39 - Compressive Strength of Cylindrical Concrete Specimens

EYECARE MEDICAL GROUP
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5. C 94 - Ready-Mixed Cement
6. C 150 - Portland Cement
7. C 260 - Air-Entraining Admixtures for Concrete
8. C 309 - Liquid Membrane-Forming Compounds for Curing Concrete
9. C 494 - Chemical Admixtures for Concrete
10. C 1018 - Standard Test Method for Flexural Toughness and First-Crack Strength of Fiber-Reinforced Concrete (Using Beam with Third-Point Loading)
11. C 1116 - Type III, Sections 4.1.3 and 4.2, and Performance Level I, Toughness Index I5 outlined in Section 21, Note 17, Standard Specification for Fiber- Reinforced Concrete and Shotcrete

C. Federal Specifications (FS):

1. TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI- Manual of Standard Practice and Recommended Practice for Placing Reinforcing Bars (MSP-latest edition)

E. American Welding Society (AWS)

F. Scaffolding and Shoring Institute (SSI):

1. Scaffolding and Shoring Safety Rules

1.5 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

1. Provide cement manufacturer's letter of certification and chemical content test results stating that the Portland cement is in compliance with ASTM designation C 150 and ASTM C 845.
2. Indicate amounts of mix water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

D. Welding Certificates: Copies of certificates for welding procedures and personnel.

E. Flatwork Certificates: Copies of supervisors "ACI Concrete Flatwork Technician" certificate.

F. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

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- G. Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:
1. Cementitious materials and aggregates.
 2. Form materials and form-release agents.
 3. Steel reinforcement and reinforcement accessories.
 4. Fly ash materials history and origin.
 5. Fiber reinforcement.
 6. Admixtures.
 7. Waterstops.
 8. Curing materials.
 9. Floor and slab treatments.
 10. Bonding agents.
 11. Adhesives.
 12. Vapor retarders.
 13. Epoxy joint filler.
 14. Joint-filler strips.
 15. Repair materials.
- H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed concrete Work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
1. Flatwork (interior and exterior slabs) shall be placed, finished and cured under the direct supervision of a “Certified ACI Concrete Flatwork Technician”.
- B. 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 formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.
1. Manufacturer must be certified according to the Department of Transportation’s “Certificate of Ready Mixed Concrete Production Facilities”.
- D. Testing Agency Qualifications: An independent testing agency, approved by the Engineer and acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

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- E. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.
- F. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."
- G. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
 - 1. ACI 301, "Specification for Structural Concrete."
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- H. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Meetings."
 - 1. Flatwork (interior and exterior slabs) Preinstallation Conference: Conduct conference at Project site to review all details and requirements for the batching, mixing, transporting, placing, finishing, and curing all interior and exterior flatwork operations. Require representatives of each entity directly concerned with flatwork operation to attend, including the following:
 - a. Contractor and Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixes.
 - c. Ready-mix concrete producer.
 - d. Flatwork subcontractors.
 - e. Quality assurance firm.
 - f. Cement Manufacturer's factory representative
 - g. Testing agency
 - h. Engineer.
 - i. Owner's representative.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Use earth forms where possible to eliminate the use of formwork.
- B. Provide reusable forms.
- C. For new wood formwork, provide FSC-certified lumber.
- D. Use recycled-content formwork.

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- E. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1, or better.
 - b. Medium-density overlay, Class 1, or better, mill-release agent treated and edge sealed.
 - c. Structural 1, B-B, or better, mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1, or better, mill oiled and edge sealed.
 - 2. Manufactured forming system: metal or other panel system with prior review and approval.
- F. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- G. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish ties that, when removed, will leave holes not larger than 1 inch in diameter in concrete surface.
 - 2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
 - 1. Bars shall be clean and free from rust, scale or coatings that will reduce bond. Reinforcing steel shall be capable of bending 180 degrees and rebending to original shape without fracture.
- B. Low Alloy Steel Reinforcing Bars for Welding: ASTM A706, deformed.
- C. Plain-Steel Wire: ASTM A 82, as drawn.
- D. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

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2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected or CRSI Class 2 stainless-steel bar supports.
- B. Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60. Cut bars true to length with ends square and free of burrs.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type II – Low Alkali, ASTM C114, expressed as sodium oxide (Na_2O), of less than 0.60%.
- B. Portland Cement: ASTM C 150, Type V.
 - 1. Fly Ash: ASTM C 618, Class C or F.
 - a. Manufacturer to provide evidence that fly ash is free of radon.
 - 2. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
 - a. At the supplier's option, slag cement may be blended with type II cement to achieve the performance of 0.60% alkali. The cement supplier shall provide a letter certifying the percentage of slag cement required to achieve the performance of low alkali cement specified.
- C. Normal-Weight Aggregate: ASTM C 33, uniformly graded, and as follows:
 - 1. Class: Severe weathering region, but not less than 3S.
 - 2. Nominal Maximum Aggregate Size: 3/4 inch.
 - 3. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 sieve, and less than 8 percent may be retained on sieves finer than No. 50.
- D. Water: Potable and complying with ASTM C 94.

2.5 ADMIXTURES

- A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material and to be compatible with other admixtures and cementitious materials. Do not use admixtures containing calcium chloride.

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- B. Air-Entraining Admixture: ASTM C 260. Sika AER by The Sika Chemical Corp. or approved equal
- C. Air-Entraining Admixture (Flowable Fill): DuraFill by W.R. Grace or approved equal.
- D. Water-Reducing Admixture: ASTM C 494, Type A. Eucon WR-75 by the Euclid Chemical Co., "Pozzolith 200N" by Master Builders, "Plastocrete 161" by the Sika Chemical Corp., or approved equal.
- E. Non-Corrosive Accelerator: ASTM C 494, Type C or E, Accelguard 80 by the Euclid Chemical Co. or "Polar Set" by W. R. Grace and Co. or approved equal.
 - 1. Non –corrosive accelerator shall have long-term test data proving its non-corrosive effect on reinforcing steel.
- F. Concrete Moisture Vapor Reduction Admixture (MVRA): Concrete moisture vapor reduction admixture for all interior slab on ground construction shall be a non-toxic, liquid admixture that is specifically designed to have a natural chemical reaction with pre-existing elements inside the concrete to eliminate the route of moisture vapor emission through the slab by restricting the integral capillary system. The chemical reaction forms a permanent barrier (capillary break) that is integral to the concrete, insoluble and irremovable.
 - 1. Basis-of-Design Product: **“Barrier One High Performance Concrete Admixture”** manufactured by Barrier One, Inc.; 522 S. Hunt Club Blvd., #303, Apopka, Florida 32703; Contact Manufacturer’s representative: P: 877.224.5850, F: 866.594.3490 or Email at: info@barrierone.com .
 - 2. Provide the above named product or, upon approval of the Architect/Structural Engineer, provide a product that meets or exceeds the below project specific performance requirements at the expense of the concrete moisture vapor reduction admixture (MVRA) manufacturer:
 - a. Project specific quality control process to include but not limited to:
 - 1) Independent procurement of one cylinder per day of placement of concrete containing MVRA; do not proceed without MVRA representative being present
 - 2) Independent testing of all cylinders for hydraulic conductivity per ASTM D5084
 - 3) Assessing each cylinder for maximum flow of 6.0 E-08 cm/sec
 - 4) Should any cylinder exceed the maximum flow, procure a core from that day’s placement
 - 5) Independently test core for hydraulic conductivity per ASTM D5084
 - 6) Should any core exceed the maximum flow, provide a topical moisture mitigation system for all areas not meeting the stated limit; moisture mitigation system to include all labor, material and warranty that meets or exceeds the terms of the concrete moisture vapor reduction admixture manufacturer’s warranty
 - b. Warranty requirements: Said product must be installed according to and in compliance with the manufacturer’s published data sheet to include but not limited to dosing instructions, onsite representation requirements, and the use of an ASTM

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E 1745 vapor retarder, installed following ASTM E 1643 and ASTM F 710 guidelines; suspended concrete slabs do not require a vapor retarder.

- 1) MVRA Manufacturer's warranty shall include:
 - a) Term: Life of the concrete
 - b) Repair and/or removal of failed flooring
 - c) Placement of a topical moisture remediation system
 - d) Replacement of flooring materials like original installed to include material and labor
- 2) MVRA Manufacturer shall provide an adhesion warranty to match the term of the adhesive manufacturer's warranty in accordance with the MVRA manufacturer's requirements for conveyance of such

2.6 FIBER REINFORCEMENT

- A. Synthetic Fiber: Fibrillated or monofilament polypropylene fibers engineered and designed for use in concrete, complying with ASTM C 1116, Type III, 1/2 to 1-1/2 inches long.
- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Monofilament Fibers:
 - a. Fibrasol IIP; Axim Concrete Technologies.
 - b. Fiberstrand 100; Euclid Chemical Co.
 - c. Fibermix Stealth; Fibermesh, Div. of Synthetic Industries.
 - d. Forta Mono; Forta Corporation.
 - e. Grace MicroFiber; W. R. Grace & Co., Construction Products Div.
 - f. Hi-Tech PPM Fiber; Hi-Tech Fibers, Div. of Martin Color-Fi, Inc.
 - g. Polystrand 1000; Metalcrete Industries.

2.7 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Manufactured rectangular or trapezoidal strip, sodium bentonite or other hydrophylic material for adhesive bonding to concrete. Parastop II by Paramount Technical Products, Inc. or approved equal.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Volclay Waterstop-RX; Colloid Environmental Technologies Co.
 - b. Conseal CS-231; Concrete Sealants Inc.
 - c. Swellseal Joint; De Neef Construction Chemicals (U.S.) Inc.
 - d. Hydrotite; Greenstreak.
 - e. Mirastop; Mirafi Moisture Protection, Div. of Royal Ten Cate (USA), Inc.
 - f. Adeka Ultra Seal; Mitsubishi International Corporation.
 - g. Superstop; Progress Unlimited Inc.
 - h. Parastop II; Paramount Technical Products, Inc.

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2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete. Evaporation retarder shall be “Con-film” by Master Builders or approved equal.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz. /sq. yd. dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Clean and Potable.
- E. Curing Compound (Exterior Concrete Application): Conform to method of ASTM C 156 for compliance with ASTM C 309, non-coloring, non-staining, curing compound. Curing compound shall be Sonocrete SONOSIL as manufactured by Sonneborn – Chemtrex, Inc. or approved equal.
- F. Curing and Sealing Compound (Exposed Interior Concrete Slab Application): Conform to Federal Spec. TT-C-800A, 30 percent solids content minimum. Curing and sealing compound shall be "Super Floor Coat" by the Euclid Chemical Co., "Master-Seal" by Master Builders, or approved alternate.
- G. Waterproof Paper for Curing and Protection (Interior Non-Exposed Concrete): Conform to ASTM C 171, Type I. Paper shall be lapped and seams taped with reinforced tape, orange label Sisalcraft, Floor Cure Wet Strength by Glas-Kraft, Inc., or approved equal.

2.9 RELATED MATERIALS

- A. Isolation Joint Former (Columns): 24" x 24" diamond/square as manufactured by Greenstreak, P.O. Box 7139, St. Louis, MO 63177, or approved equal.
- B. Perimeter Isolation Joint: 2 lb. density, cross linked polyethylene with removable strip-off equal to ISO-STRIP as manufactured for Century Floors, Topsham, Maine.
- C. Joint-Filler Strips: ASTM D1571, asphalt-saturated cellulosic fiber or high recycled-content product complying with ASTM D1571.
 - 1. Product: “Homex 300” by Homasote CO. (West Trenton, NJ, 800.257.9491).
- D. Epoxy Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Shore A hardness of 80 per ASTM D 2240.
- E. Deicer Protection (Exterior Concrete): Saltgard as manufactured by Pro So Co, Inc., or approved equal.
- F. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

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- G. Epoxy-Bonding Adhesive: A two-component, solvent-free, moisture-insensitive structural epoxy adhesive in compliance with ASTM C 881, Type I and Type II, Grade 2, Class B and C, and shall be Sikadur 32, Hi-Mod by Sika Corp. or approved equal.
- H. Doweling Adhesive: A two-component, vinylester blend resin equal to HI HY150 adhesive as manufactured by Hilti Fastening Systems, Tulsa, Oklahoma or approved equal
- I. Floor Control/Construction Joints: Control joints shall be saw cut or 1/4" wide soff-cut. Construction joints shall be keyed and doweled. Key joint is of 24 gauge galvanized steel with 1-1/8" dowel knockouts 6" on center. Keyway shall be equal to "Key-Lock Joint" with removable plastic cap strip by Form-A-Key Products Div., Louisville, KY 40214, or approved equal.
- J. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- K. Weep Holes: 2" diameter PVC pipe.
- L. Non-Shrink Grout: Premixed compound with non-metallic aggregate, cement, water-reducing and plasticizing agents capable of minimum compression strength of 2,400 lbs. Non-shrink grout shall be "Eucon N-S" (non-metallic) by the Euclid Chemical Co., "Masterflow 713" (non-metallic) by Master Builders, Five Star Grout by U.S. Grout Corp., or approved equal.

2.10 REPAIR MATERIALS

- A. Slurry: Slurry shall consist of the same proportions of cement to fine aggregates used in the regular concrete mix (coarse aggregate only omitted) and shall be well mixed with such amount of water as will produce a thick consistency.
- B. Dry Pack: Dry pack for cosmetic concrete repairs only shall consist of one part cement to 2-1/2 parts fine aggregate (screen out all materials retained on No. 4 sieve), mixed with a minimum amount of water, in small amounts. The consistency shall be such that when a ball of the mixture is compressed in the hand it will maintain its shape, showing finger marks, but without showing any surface water.
- C. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- D. Repair Topping: Traffic-bearing, cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch.

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1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5700 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXES

- A. Prepare design mixes for each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:
 1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.
 1. DO not use Owner's field quality control testing agency as the independent testing agency.
- C. Cementitious Materials: Limit percentage, by weight, of Cementitious materials other than Portland cement in concrete as follows:
 1. Fly ash: 25 percent.
 2. Combined Fly ash and pozzolans: 25 percent.
 3. Ground Granulated Blast Furnace Slag: 50 percent.
 4. Combined Fly Ash or Pozzolans and Ground Granulated Blast Furnace Slag: 50 percent Portland cement minimum, with fly ash or pozzolans not exceeding 25 percent.
- D. Footings and foundation walls: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.49.
 3. Maximum Aggregate size: 3/4"
 4. Slump Limit: 4 inches, plus or minus 1 inch.
 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- E. Interior Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:
 1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.52.
 3. Maximum Aggregate size: 3/4"
 4. Slump Limit: 5 inches.
 5. Air Content: Do not allow air content of troweled finished floors to exceed 3 percent.
 6. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

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- F. Suspended Slabs: Proportion structural lightweight concrete mixture as follows:
1. Minimum Compressive Strength: 3500 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.49.
 3. Calculated Equilibrium Unit Weight: 110 lb/cu. ft., plus or minus 3 lb/cu. ft. as determined by ASTM C 567.
 4. Slump Limit: 4 inches, plus or minus 1 inch.
 5. Air Content: 7 percent, plus or minus 2 percent at point of delivery for nominal maximum aggregate size 3/8 inch or less.
 6. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.5 lb/cu. yd..
- G. Miscellaneous Site Concrete not specified in other sections: Unless otherwise indicated, proportion normal-weight concrete mix as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 3. Aggregate size maximum 3/4".
 4. Slump Limit: 5 inches.
 5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- H. All concrete shall contain the specified water-reducing admixture. All slabs placed below 50 degrees F shall contain the specified non-corrosive accelerator. All exterior concrete shall contain an approved air-entraining admixture.
- I. All exterior concrete shall have an air content of five percent to seven percent.
- J. All exterior concrete subjected to freezing and thawing shall have a maximum water-cement ratio of 0.53. All concrete subjected to deicers shall have a maximum water-cement ratio of 0.45.
- K. No air entrainment in interior floor slab.
- L. Limit water soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- M. All mix design, batching, placing, finishing, curing, joint sealing and patching of color conditioned concrete shall be in strict accordance with the manufacturers recommendations
- N. Flowable Fill:
1. Flowable fill shall be excavatable, composed of a homogenous mixture of Type II Portland cement, fine aggregate, water, and air-entraining admixture proportioned according to these specifications. All material shall be approved prior to use.
 2. Flowable Fill Limits:
 - a. Laboratory Design Compressive Strength 100 psi at 28 days
 - b. Cement Factor 70-100 lbs/cy

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c.	Water-Cement Ratio	3.00*
d.	Air Content	20% to 25%**
e.	Modified slump	7" to 8"

Notes

*The water-cement ratio for Flowable fill shall not be high enough to cause segregation of the mix.

**Air content of 20% to 25% is the target. Higher air contents may be acceptable but will increase set time. All Flowable fill shall be air-entrained by the addition of an air-entraining admixture in strict accordance with the manufacturer's recommendations and written instructions.

- O. Air Content: Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 5 to 7 percent, unless otherwise indicated.
- P. Do not air entrain concrete to trowel-finished interior floors and suspended slabs. Do not allow entrapped air content to exceed 3 percent.
- Q. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.
- R. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1 lb/cu. yd..
- S. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
 - 4. Use corrosion-inhibiting admixture in concrete mixes where indicated.

2.12 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.13 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.

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1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until concrete structure can support such loads.
 1. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Excessive deflection of forms after concrete is poured shall be sufficient cause for rejection of that portion of concrete and formwork. Excessive deflection will be considered to be that which will produce visible and noticeable waves in the finished concrete.
 2. Construct forms so that walls will key into each other at ends unless poured monolithically.
- B. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
 1. Class A, 1/8 inch.
- C. Construct forms tight enough to prevent loss of concrete mortar.
- D. All possible care shall be taken in the formwork to produce surfaces free from honeycomb or other defects.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.
 1. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

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- H. Schedule the work and notify other trades in time so that provisions for their work in the formwork can be made without delaying progress of the project. Verify that all sleeves, pipes, etc., for electrical, plumbing, heating and ventilation, or other work are installed.
- I. Chamfer exterior corners and edges of permanently exposed concrete.
- J. Do not chamfer corners or edges of concrete.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- L. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- M. Bolts, rods or other approved devices shall be used for internal ties. They shall be so arranged that when the forms are removed, no metal shall be within 1" of any surface.
- N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Secure information about and provide for all openings, offsets, recessed nailing blocks, channel chases, anchors, ties, inserts, etc., in the formwork before concrete is poured.
 - 2. Install anchor bolts, accurately located, to elevations required.
 - a. The setting of all anchor bolts and the grouting for all structural steel base plates shall be included as part of this contract. Bolts and base plates will be furnished under Section 05500 - Metal Fabrications.
 - b. All column base plates, equipment bases, and other locations noted in the structural drawings shall be grouted with the specified non-shrink grout. All exposed grout shall be the specified non-metallic type.
 - 3. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than

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50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

- B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:
 - 1. 28-day design compressive strength.
 - 2. At least 70 percent of 28-day design compressive strength.
 - 3. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
 - 4. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Engineer.

3.4 SHORES AND RESHORES

- A. Comply with ACI 318, ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. All steel bars, wire and fabric shall be of size, gauge and length indicated, accurately bent or formed to shapes detailed or scheduled by experienced shops using methods that will not injure the materials.
 - 2. Steel reinforcing shall not be bent in a manner that will injure the material or the embedding concrete. Bars with kinks or bends not shown on the plans shall not be used. Heating of reinforcement for bending will not be permitted. Bars shall be bent once only (no rebending or straightening allowed) unless shown as such on the drawings.
 - 3. All details of reinforcement not shown or indicated on the drawings or specifically called for in the specifications shall conform to ACI 315.

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4. Lap all bars at splices, corners and intersections a minimum of 36 bar diameters unless otherwise indicated. Laps of welded-wire fabric shall be at least two times the spacing of the members in the direction lapped but not less than twelve inches.
 5. All intersecting concrete walls shall be tied with #4L bars 3'-0" long, bent 18" x 18" spaced 12" on center, outside face only unless otherwise indicated.
 6. Splices of reinforcement shall not be made at points of maximum stress. Splice lengths shall be a minimum of 36 bar diameters unless otherwise indicated and shall provide sufficient lap to transfer the stress between bars by bond and shear. Stagger splices of adjacent bars where possible. All splices and laps at corners and intersections shall be tied with wire at each end.
 7. Where obstructions (pipes, conduit, ducts, etc.) prevent the intended placement of reinforcing, provide additional reinforcing as directed by the Engineer or his Representative around the obstruction to match that reinforcing interrupted.
 8. Provide additional stirrups, ties, trim bars, etc., as directed around all openings, sleeves, pipes, and conduits, which pass through structural elements.
 9. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials. .Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
1. Coverage of bars (including stirrups and column ties) shall, unless otherwise shown, be as follows:
 - Footings: 3" soil face, 2" top
 - Slabs (on grade): 2" soil face, 1-1/2" top face
 - Slabs (elevated): 1" top and bottom
 - Beam and Column: 1-1/2"
 - Walls: 2" clear to form at exterior
 2. Misplaced Reinforcing: If any reinforcing bars are found to be misplaced after concrete has been placed, the Engineer shall be notified immediately and no correction or cutting shall be made without his direction. Misplaced bars shall not be bent or kinked. Any redesign and/or reinforcing required because of misplaced bars shall be at the Contractor's expense.
 3. All reinforcing shall be kept separate from soil, pipe, conduit ducts, etc., by approved non-metallic separators.
 4. Reinforcement shall not have welded joints unless indicated on the drawings or unless prior approval has been given by the Engineer. Welding shall conform to the requirements of the American Welding Society Structural Welding Code for reinforcing steel D1.4. Field welding shall be performed by AWS certified welders.
 5. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

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1. At edges of slabs, construction joints, and expansion joints, extend fabric to within one inch of pour. As concrete for slabs is placed, support fabric reinforcement at intervals to ensure proper embedment. Support fabric in mid-depth of slab. All weld wire mesh shall be located one-half the thickness of the slab unless otherwise noted on the drawings.
2. Extend fabric over supporting beams and walls.

3.6 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form from preformed galvanized steel, plastic keyway-section forms, or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - a. Wall control "V" joints shall have a depth of 1/8 times the thickness of the wall and be 1/2" wide at surface. "V" joints shall be placed as shown or as directed by the Engineer.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness, or 3/4" minimum for soft-cut as follows:
 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/4" (maximum) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
 - a. Floor slab control joints (including elevated slabs) shall be placed as shown on the foundation plan (slab on grade). Unless otherwise noted, control joints shall be spaced at intervals not to exceed 12'-0" on center in both directions.

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- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 7 Section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Dowel Joints: Install dowel sleeves and dowels or dowel bar and support assemblies at joints where indicated.
1. All new concrete walls shall be tied to existing concrete walls with #6 dowels, 20" long at 8" on center, drilled 8" into existing concrete unless otherwise indicated. Dowels shall be set in doweling adhesive in strict accordance with the manufacturer's recommendations
 2. All intersecting slab construction joints acting as control joints shall be doweled according to the following schedule unless otherwise indicated. Dowels shall be smooth, steel grade 60 with saw cut ends. Grease, wrap or cap one end.
- F. Dowel Schedule:
- G.
- | Slab | bar dia. | Length | spacing |
|---------|----------|--------|---------|
| 4" slab | 1/2" | 12" | 12" |
| 5" slab | 5/8" | 14" | 12" |
| 6" slab | 3/4" | 14" | 12" |
- H. New slabs shall be tied to existing slabs with #6 bars 12" long at 8" on center.

3.7 WATERSTOPS

- A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated, according to manufacturer's written instructions, bonding or mechanically fastening and firmly pressing into place. Install in longest lengths practicable.
1. Remove all protrusions and indentations 2" or over in all areas.
 2. Lay waterstop flat against concrete surface and nail every 1" to 6" with case hardened washered nails.
 3. Overlap all joints a minimum of 2" .

3.8 WEEP HOLES

- A. Provide weep holes at a minimum of 10'-0" on center at the base of all perimeter foundation walls with underdrains unless indicated otherwise.

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3.9 MIXING CONCRETE

- A. General: The concrete shall be mixed in the quantities required for immediate use, and any which has developed initial set or exceed the time limit of ASTM C 94 shall not be used. No retempering of mortar or concrete shall be allowed under any circumstances. Concrete shall be proportioned, mixed and placed only in the presence of the Engineer or his Authorized Representative. The Contractor shall give ample notice to the Engineer before mixing is commenced. Aggregate size will be adjusted to suit conditions of work. Pumping of concrete shall be permitted only after approval by the Engineer of the Pumping Contractor and the pumping equipment and method to be employed. The Engineer shall be notified of dates when pumping of concrete shall be performed to permit his on-the-job inspection of the operations.
- B. Final proportions shall be in accordance with approved mix designs. Adjustments to approved proportions, for whatever reason, shall be approved by the Engineer.
- C. Add fibrous concrete reinforcing to all concrete used at slabs on grade, slabs on metal deck, and structural slabs and sidewalks. The amount of fiber reinforcement shall be in accordance with the manufacturer's recommendations and approved submittals. Add the fibrous reinforcement at the time the concrete is batched; mix in strict accordance with the manufacturer's instructions and recommendations for a uniform and complete distribution.

3.10 CONCRETE SUBSTRATES PREPARATION:

- A. Prepare according to ASTM F 710.
- B. Prepare substrates according to manufacturer's written instructions to insure adhesion of flooring products
- C. Extensive surface preparation is required over substrates from which existing products have been removed. Requirements vary among manufacturers. Insert requirements to suit Project.
- D. Verify that substrates are dry and free of curing compounds, sealers, and hardeners. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
- E. Slab Porosity and Adhesion Testing: Perform tests recommended by manufacturer, following each individual adhesive manufacturer's application instructions for use on non-porous substrates if applicable.
- F. Moisture Testing: As specified in Division 03 Section "Cast-In-Place Concrete". No further moisture testing shall be required prior to installation of the floor coverings.
- G. Alkalinity Testing: Not required prior to installation of the floor coverings.

3.11 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

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- B. Remove loose dirt, mud, standing water, and foreign matter from excavations or from cavities.
- C. Thoroughly clean reinforcement and other embedded items free from loose rust and other matter. Assure reinforcing is held securely in place.
- D. Thoroughly wet wood forms (except coated plywood), bottom and sides of trenches, base underslab, and adjacent concrete or masonry at least one hour in advance of placing concrete; securely close cleanout and inspection ports; repeat wetting as necessary to keep forms damp.
- E. Equipment shall be maintained clean and of sufficient quantity and capacity to efficiently execute the work required.
- F. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer.
- G. Before placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mix.
- H. Deposit concrete continuously or in layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as specified. Deposit concrete to avoid segregation.
- I. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.
 - 1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
 - a. Concrete shall be vibrated into final position in forms with an internal type vibrating machine. The vibration shall have a frequency of not less than 8,000 vibrations per minute. The mechanical vibrating equipment shall be satisfactory to the Engineer.
 - b. The vibration shall be of sufficient intensity and duration to cause flow or settlement of the concrete and complete consolidation. Over vibration, especially of mixtures that are too wet, may cause segregation and will be avoided. A sufficient number of vibrators shall be provided to permit consolidation of each batch before the next batch is delivered and without delaying the delivery.
 - c. The vibrations shall be applied directly to the concrete, and vibration through the forms shall not be permitted. Vibration shall be applied at the point of deposit and in the area of freshly deposited concrete. The concrete shall be placed in layers of uniform thickness
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to

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- consolidate concrete and complete embedment of reinforcement and other embedded items without causing mix constituents to segregate.
3. When conditions make puddling difficult, or where the reinforcement is congested, batches of mortar containing the same proportions of cement to sand used in the concrete shall be deposited in the forms. The operation of filling with the regularly specified mix shall be carried on at such a rate that the mix is at all times plastic and flows readily into the spaces between the bars.
 4. In thin walls or inaccessible portions of the forms where rodding is impractical, the concrete shall be worked into place by tapping or hammering forms adjacent to the freshly deposited concrete.
 5. The Contractor's attention is called to the importance of making the concrete dense, and he shall provide sufficient labor to the entire satisfaction of the Engineer to thoroughly consolidate the concrete, avoid air pockets and voids in exposed sections, and leave smooth, uniform surfaces after forms are removed.
 6. Should any honeycombed concrete be disclosed upon removal of forms, the Contractor shall immediately cut out the said honeycombed portions back to solid concrete and shall fill the opening thus formed with a concrete of the same proportions as that specified for the section of work in which the fault occurs.
 7. When placing fresh concrete upon hardened concrete, the latter shall be thoroughly roughened and cleaned of all loose material, scum or latency. The bonding compound shall be applied and the new concrete placed while the bonding compound is still tacky.
 8. Joints in the concrete work shall be made only in places and the manner specified by the Engineer.
 9. The Contractor's attention is called to the importance of properly and carefully placing concrete around reinforcement, as the reinforcing metal must not be exposed; and in cases where reinforcing metal becomes exposed on the surface, that portion of work must be removed and re-laid as the covering of same by plastering with cement mortar will not be allowed. All reinforcing rods or other reinforcing material shall be lightly tapped so that they will retain their original position.
 10. No concrete shall be retempered except as allowed in ASTM C 94 nor shall set concrete be used as aggregate.
- J. Flowable fill placement methods and sequences shall be approved by the Engineer before the start of any placement operation.
1. Fill shall be placed before it has taken initial set. Fill shall be placed in such a manner as to avoid separation and segregation of the mix.
 2. Consolidation, tamping, or vibration is not required and shall not be allowed.
 3. The drop height of shall be as low as practically possible.
 4. Fill shall not be placed until fill area has been checked and approved by the Owners Representative.
- K. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 2. Maintain reinforcement in position on chairs during concrete placement.
 - a. Reinforcement, unless otherwise indicated, shall be placed one-half the thickness of the slab.

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3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 4. Slope surfaces uniformly to drains where required.
 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
 6. In addition to steel bar and/or welded-wire fabric reinforcement, slabs shall be reinforced with fibrous concrete reinforcement which is to be added when the concrete is being batched in strict accordance with the manufacturer's recommendations.
 7. Slabs shall be monolithically placed with control joints. Sawed control joints will be located as indicated on the drawings and/or as directed by the Engineer. Floors shall be cleaned of objects before saw cutting begins. A true, continuous saw cut is what is expected as a finish result.
 8. Slabs designated as colored in the room finish schedule shall be placed in strict accordance with manufacturers recommendations. The concrete shall never be covered with plastic sheathing.
- L. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
 4. Contractor shall have on the job, ready to install, adequate equipment for heating the materials and the freshly placed concrete and for enclosing the work in accordance with the requirements specified herein.
- M. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows, when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.
- N. Protection:
1. Concrete just placed shall be protected from rain in an approved manner until the concrete has set, or if a slab, the curing compound has dried.
 2. Concrete, when placed in the forms, shall have a temperature of not less than 50 degrees F nor more than 90 degrees F. Freshly placed concrete and the surrounding air shall be maintained at a temperature of 50 degrees F or greater for a period of seven days after placing. If high early strength concrete is used, the aforementioned time period may be

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reduced to three days. The methods of protection and curing shall be such as to prevent evaporation of moisture from the concrete and injury to the surface.

3. Should it later develop that any concrete work has become injured in any way by freezing or otherwise, the defective concrete shall be repaired or replaced as directed by the Engineer at no added expense to the Owner. Repair materials shall include all reinforcement grouts, dry pack, admixtures, epoxy and aggregates as may be necessary

O. Deicer Protection:

1. Apply deicer protection to all exterior slabs on grade, stairs, sidewalks, and related work 30 days after concrete placement in strict accordance with manufacturer's written recommendations.

3.12 PROTECTIVE COATING FOR STRUCTURAL STEEL

- A. All structural steel and columns and their bases which extend into or through concrete floors or walls shall be thoroughly brush painted with two coats of foundation coating as specified in Section 07150 - Dampproofing, and applied in accordance with the manufacturer's directions, neatly cut off one inch below finish floor.

3.13 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.

- C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix one part portland cement to one and one-half parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part portland cement and one part fine sand with a 1:1 mixture of bonding agent and water.

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Add white portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

- D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.14 FINISHING FLOORS AND SLABS

- A. General: Comply with recommendations in ACI 302.1R for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
1. All interior concrete floor slabs shall be finished true and smooth by steel troweling or finishing machine. All exterior slabs, pads, ramps, stairs, and sidewalks shall be broom finished.
 2. When a section of the concrete floor is completed, it shall be left entirely undisturbed until the concrete is thoroughly hardened.
 3. Adequate provisions will be made to eliminate the possibility of accidental encroachment upon the newly concreted area.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes.
1. Apply scratch finish to surfaces indicated and to surfaces to receive concrete floor topping or mortar setting beds for ceramic or quarry tile, portland cement terrazzo, and other bonded cementitious floor finishes.
- C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
1. Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- D. Trowel Finish: After applying float finish, apply first trowel finish and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces indicated and to floor and slab surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin film-finish coating system
- E. Trowel and Fine-Broom Finish: Apply a partial trowel finish, stopping after second troweling, to surfaces indicated and to surfaces where ceramic or quarry tile is to be installed by either

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thickset or thin-set method. Immediately after second trowelling, and when concrete is still plastic, slightly scarify surface with a fine broom.

- F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- G. Slip-Resistive Aggregate Finish: Before final floating, apply slip-resistive aggregate finish where indicated and to concrete stair treads, platforms, and ramps. Apply according to manufacturer's written instructions and as follows:
 - 1. Uniformly spread 25 lb/100 sq. ft. of dampened slip-resistive aggregate over surface in one or two applications. Tamp aggregate flush with surface, but do not force below surface.
 - 2. After broadcasting and tamping, apply float finish.
 - 3. After curing, lightly work surface with a steel wire brush or an abrasive stone, and water to expose slip-resistive aggregate.
- H. Mineral Dry-Shake Floor Hardener Finish: After initial floating, apply mineral dry-shake materials to surfaces according to manufacturer's written instructions and as follows:
 - 1. Uniformly apply mineral dry-shake materials at a rate of 100-lb/100 sq. ft., unless greater amount is recommended by manufacturer.
 - 2. Uniformly distribute approximately two-thirds of mineral dry-shake materials over surface by hand or with mechanical spreader, and embed by power floating. Follow power floating with a second mineral dry-shake application, uniformly distributing remainder of material, and embed by power floating.
 - 3. After final floating, apply a trowel finish. Cure concrete with curing compound recommended by dry-shake material manufacturer and apply immediately after final finishing.

3.15 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

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- D. Mechanical Equipment Pads: Provide 4" concrete pads reinforced with 6x6 - W1.4xW1.4 welded-wire fabric under all mechanical equipment supported on concrete floor slab unless otherwise indicated.
- E. Foundation Insulation: Install foundation insulation using a dab of emulsified asphalt mastic in each corner and the center to adhere the insulation to the concrete wall. Insulation will be installed on the inside face of all perimeter foundation walls extending from the underside of floor slab to top of footing. Insulation furnished under Division 7.

3.16 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and with recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces as indicated below

1. Interior:

- a. Exposed concrete slabs (excluding shrinkage compensating concrete slabs and slabs scheduled to receive curing/sealer/hardener floor finish) shall receive the specified curing and sealing compound applied immediately following final finishing operations and in strict accordance with the manufacturer's recommendations.
- b. All concrete slabs designated as colored in the room finish schedule shall be cured and sealed in strict accordance with manufacturer recommendations.
- c. Slabs as indicated on the Room Finish Schedule shall receive the specified curing/sealer/hardener as follows:
 - 1) Apply immediately following the final concrete finishing operation of the concrete floor slab and as soon as the concrete is firm enough to work on in strict accordance with the manufacturer's recommendations and written instructions.

2. Exterior:

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- a. Concrete slabs, pads, stairs, ramps, sidewalks, and related work shall receive the specified curing compound applied in strict accordance with the manufacturer's written recommendations.
 - b. Concrete slabs, pads, stairs, ramps, sidewalks, and related work shall receive the specified deicer protection 30 days after concrete placement in strict accordance with the manufacturer's written recommendations.
3. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
- a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
4. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.
5. Waterproof Paper (gymnasium floor): Apply waterproof paper in accordance with manufacturer's recommendations in widths as wide as possible. Paper shall be lapped and seams taped with reinforced tape.
6. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.17 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling (*until concrete has aged at least six months*) (OR) (*till the completion of the project*). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid epoxy joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

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- D. Install isolation joints around columns in accordance with the drawings and manufacturer's recommendations.
- E. Install perimeter isolation joints in accordance with the drawings and manufacturer's recommendations.

3.18 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

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5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. A set of four (4) test cylinders shall be made for each 100 cubic yards, or fraction thereof, of each class of concrete placed each day. Cylinders shall be made and cured by the Testing Agency in accordance with ASTM C 31. The properly marked cylinders shall be picked up by the approved testing agency and tested in accordance with ASTM C 39. The test results will be sent directly to the Engineer with location and date marked. In addition to the date cast, the date and time the cylinders are picked up for transportation to the lab shall be shown.
 2. Description of the manner in which cylinders were stored for the first 24 hours and the succeeding 27 days shall also be indicated.
 3. Air temperature, as well as the concrete temperature, shall be shown so that there is adequate data to evaluate varying and possibly low test results.
 4. On-site slump tests will be made as directed:
 - a. Type II Cement: At placement maximum slump 4", minimum slump 2"
 - b. Flowable Fill: Slump tests shall be performed using the modified slump test as follows:

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- 1) Apparatus: Scoop, Measuring tape, flat edge, 3" x 6" cylinder mold open at both ends and a flat, nonabsorbent surface.
- 2) Procedure:
 - a) Set cylinder upright on flat, nonabsorbent surface.
 - b) Scoop representative sample of flowable fill.
 - c) Fill the cylinder with the sample in one lift without tamping. Strike off the top with the flat edge to form a level surface.
 - d) Clear any residue from around the bottom of the cylinder.
 - e) During a count of three seconds, lift the cylinder straight up allowing the sample to spread on the flat surface.
 - f) Measure the spread diameter to the nearest 2". A spread of 7" to 8" is considered flowable.
5. Air content shall be checked at least twice each day on air-entrained concrete in accordance with ASTM C 173 or ASTM C 231.
6. Air content for flowable fill shall be measured following the requirements of ASSHTO T152 utilizing Type B equipment.
7. At least one set of measurements for air content, temperature, and slump of the flowable fill mix shall be performed per placement or per day, whichever is less frequent. Test cylinders shall not be required.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

- D. Strength of each concrete mix will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
- E. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7-and 28-day tests.
- F. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- G. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42 or by other methods as directed by Engineer.

END OF SECTION 033000

SECTION 05310 - STEEL DECK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Roof deck.
- B. Related Sections include the following:
 - 1. Division 5 Section "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, and deck openings, special jointing, accessories, and attachments to other construction.
- C. Product Certificates: Signed by steel deck manufacturers certifying that products furnished comply with requirements.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."
- C. AISI Specifications: Calculate structural characteristics of steel deck according to AISI's "Specification for the Design of Cold-Formed Steel Structural Members."

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1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
- B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1.6 PROJECT CONDITIONS

- A. Design:
 - 1. Steel deck shall be designed in accordance with the AISI "Specifications for the Design of Cold-Formed Steel Structural Members." Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical.
 - 2. Design Loads: As specified on the drawings.

PART 2 - PRODUCTS

2.1 ROOF DECK

- A. Composite Steel Deck (Roof/Future 2nd Floor): Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer. Color: Manufacturer's standard.
 - 2. Deck Profile: Type VL.
 - 3. Profile Depth: 1-1/2 inches.
 - 4. Design Uncoated-Steel Thickness: 22 GAGE
 - 5. Span Condition: Double span.
 - 6. Field Fastening: 5/8" puddle welds on a 36/5 pattern
 - 7. Side Laps: fasteners #10 TEK screws (1 per span).
 - 8. Edge Angle/Beam Fastening: 5/8" puddle welds at 6" o.c.
 - 9. Perimeter Zone and Corners: 5/8" puddle welds at 6" o.c.
- B. Steel Deck (Elevator Pit): Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:
 - 1. Prime-Painted Steel Sheet: ASTM A 1008/A 1008M, Structural Steel (SS), Grade 33 minimum, shop primed with manufacturer's standard baked-on, rust-inhibitive primer. Color: Manufacturer's standard.
 - 2. Deck Profile: Type NR, narrow rib.
 - 3. Profile Depth: 9/16 inches
 - 4. Design Uncoated-Steel Thickness: 22 GAGE
 - 5. Span Condition: Double span.

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6. Field Fastening: #12 TEK screws at 12” on-center spacing
7. Side Laps: fasteners #12 TEK screws (1 per rafter span).
8. Edge Angle/Beam Fastening: #12 TEK at 6” o.c.
9. Perimeter Zone and Corners: #12 TEK screws at 6” o.c.

2.2 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Adjusting Plates: Provide adjusting plates or segments of roof units in locations too narrow to accommodate full-size roof units. As far as practical, provide plates of the same gauge and configuration as the roof units. Plates of predetermined sizes shall be factory cut.
- C. Reinforcing Plates: Provide .057” thick reinforcing plates for all openings less than 12 inches in diameter. Length and width of plates as required satisfying The Steel Deck Institute requirements.
- D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- H. Steel Sheet Accessories: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.
- I. End Closures: Provide end closures of minimum 22 gauge to close the ends at end walls, eaves, and openings through the roof.
- J. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, thickness as required by manufacturer.
- K. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and level recessed pans of 1-1/2- inch minimum depth. For drains, cut holes in the field.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 29, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.
- C. Locate decking bundles to prevent overloading of supporting members.
 - 1. Exercise special care not to damage the material or overload the decking during the entire construction period. The maximum uniform distribution storage load shall not exceed the design live load.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Simple short spans shall be avoided, and all deck units shall extend over three or more supports unless absolutely impractical. Do not use unanchored deck units as a work or storage platform.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to decking. Reinforce and frame openings through roof in accordance with the drawings for rigidity and load-carrying capacity. Holes or other openings required for the work of other trades shall be drilled or cut and reinforced by the respective trades; the deck manufacturer and the Engineer shall approve such holes or other openings larger than 6 inches in diameter.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

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3.3 DECK INSTALLATION

- A. Immediately after placement and alignment, and after inaccuracies have been corrected, permanently fasten steel roof deck and floor deck units in place. Clamp or weight deck units to provide firm contact between deck units and structural supports while fastening is being performed. Decking shall be fastened as recommended by the manufacturer unless indicated otherwise on the drawings.
- B. End Bearing: Install deck ends over supporting frame as per drawings or unless otherwise noted, with a minimum end bearing of 1-1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped **2 inches** minimum
- C. Roof Sump Pans: Install over openings provided in roof decking and weld flanges to top of deck. Space welds not more than 12 inches apart with at least 1 weld at each corner.
- D. Miscellaneous Roof Deck Accessories: finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

3.4 FIELD QUALITY CONTROL

- A. Inspect the decking top surface for flatness after installation. Place a four-foot straightedge across the decking ribs over the structural supporting members at all locations. If the straightedge fails to touch the entire top surface of the decking or if top surfaces of abutting units are not in alignment, corrective measures or replacement shall be provided. After corrective measures or replacement has been performed, the decking shall be reinspected.
- B. Field welds will be subject to inspection.
- C. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- D. Remove and replace work that does not comply with specified requirements.

3.5 REPAIRS AND PROTECTION

- A. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
- B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05310

SECTION 055000 - METAL FABRICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Steel framing and supports for mechanical and electrical equipment.
 - 2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
 - 3. Loose bearing and leveling plates.
- B. Products furnished, but not installed, under this Section include the following:
 - 1. Loose steel lintels.

1.3 ACTION SUBMITTALS

- A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
 - 1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
 - 2. Provide templates for anchors and bolts specified for installation under other Sections.
 - 3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."

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1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
 - 2. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. 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.
- B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Steel Tubing: ASTM A 500, cold-formed steel tubing.
- C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.3 FASTENERS

- A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

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- B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
- C. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 for bolts and ASTM F 594 for nuts, Alloy Group 1.
- D. Anchor Bolts: ASTM F 1554, Grade 36.
 - 1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
- E. Eyebolts: ASTM A 489.
- F. Machine Screws: ASME B18.6.3.
- G. Lag Bolts: ASME B18.2.1.
- H. Wood Screws: Flat head, ASME B18.6.1.
- I. Plain Washers: Round, ASME B18.22.1.
- J. Lock Washers: Helical, spring type, ASME B18.21.1.
- K. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.
- L. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
 - 1. Material for Anchors in Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633, Class Fe/Zn 5.
 - 2. Material for Anchors in Exterior Locations: Alloy Group 1 stainless-steel bolts complying with ASTM F 593 and nuts complying with ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

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- C. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
 - 1. Available Products:
 - a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
 - b. ICI Devoe Coatings; Catha-Coat 313.
 - c. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
 - d. PPG Architectural Finishes, Inc.; Epoxy Zinc Rich Primer 97-670.
 - e. Sherwin-Williams Company (The); Zinc Clad IV, B69A8/B69V8.
 - f. Tnemec Company, Inc.; Tneme-Zinc 90-97.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.
 - 1. Available Products:
 - a. Sealmastic, Type 1; W. R. Meadows
 - b. Hydrocide 600; Sonneborn Building Products.
 - c. Karnak 100 AF; Karnac Chemical Corp.
- F. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.
 - 1. Available Products:
 - a. Five Star Grout by Five Star Products, Inc.
 - b. Masterflow 928 Grout by Master Builders Technologies.
 - c. SonogROUT 10K by Sonneborn.
 - d. 14K Hy Flow by Sonneborn.

2.5 FABRICATION, GENERAL

- A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.
- B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.
- E. Weld corners and seams continuously to comply with the following:

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1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 2. Obtain fusion without undercut or overlap.
 3. Remove welding flux immediately.
 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.
- G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.
- I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.
1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.
- B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.
1. Furnish inserts if units are installed after concrete is placed.

2.7 LOOSE STEEL LINTELS

- A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.
- B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.
- C. Galvanize loose steel lintels located in exterior walls.

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2.8 LOOSE BEARING AND LEVELING PLATES

- A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
- B. Prime plates with zinc-rich primer.

2.9 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Finish metal fabrications after assembly.

2.10 STEEL AND IRON FINISHES

- A. Galvanizing: Provide coating for iron and steel fabrications applied by the hot-dipped process, Duragalv by Duncan Galvanizing. The galvanizing bath shall contain high grade zinc and other earthy materials. Immediately before galvanizing, the steel shall be immersed in a bath of zinc ammonium chloride. The use of the wet kettle process is prohibited. Comply with ASTM A123 for fabricated products and ASTM A 153 for hardware. Provide thickness of galvanizing specified in referenced standards.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
 - 1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- C. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

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- B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
- C. Field Welding: Comply with the following requirements:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.
- D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.
- E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

- A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

3.3 INSTALLING BEARING AND LEVELING PLATES

- A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.
- B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
 - 1. Use nonshrink grout, nonmetallic, in concealed and exposed locations, unless otherwise indicated.
 - 2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

- A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

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- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 055000

SECTION 071113 - 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. This Section includes the following:
 - 1. Cold-applied, emulsified-asphalt dampproofing.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
- B. Material Certificates: For each product, signed by manufacturers.

1.4 PROJECT CONDITIONS

- A. Weather Limitations: Proceed with installation 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 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Degussa Building Systems; Sonneborn Brand Products.
 - 2. Karnak Corporation.
 - 3. Meadows, W. R., Inc.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1 or Type IV.

1. Available Products:

- a. Sealmastic, Type 3; W. R. Meadows
- b. Hydrocide 700; Sonneborn Building Products.
- c. Karnak 920 AF; Karnac Chemical Corp.

C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1 or Type IV.

1. Available Products:

- a. Sealmastic, Type 2; W. R. Meadows
- b. Hydrocide 700B; Sonneborn Building Products.
- c. Karnak 220 AF; Karnac Chemical Corp.

D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

1. Available Products:

- a. Sealmastic, Type 1; W. R. Meadows
- b. Hydrocide 600; Sonneborn Building Products.
- c. Karnak 100 AF; Karnac Chemical Corp.

E. VOC Content: 0.25 lb/gal. or less.

2.2 MISCELLANEOUS MATERIALS

- A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
- B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
- C. Patching Compound: Epoxy or latex-modified repair mortar or manufacturer's fibered mastic of type recommended by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of Other Work: 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.
- B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
- C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.2 APPLICATION, GENERAL

- A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
 - 1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
 - 2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.
 - 3. Allow 24 hours drying time prior to backfilling.
- B. Apply dampproofing to footings and foundation walls and elevator pit.
 - 1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches over outside face of footing.
 - 2. Extend 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
 - 3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- 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.

3.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft., or 1 trowel coat at not less than 4 gal./100 sq. ft..

3.4 CLEANING

- A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 071113

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. This Section includes the following:
 - 1. Foam-plastic board insulation.
 - 2. Spray polyurethane foam insulation.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.
- B. Research/Evaluation Reports: For foam-plastic insulation.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.
- B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
 2. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

2.2 FOAM-PLASTIC BOARD INSULATION

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and minimum compressive strength indicated below, with maximum flame-spread and smoke-developed indexes of 75 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.
 - d. Pactiv Building Products.
 2. Type IV, 25 psi.
 3. Application: Foundation insulation. Rigid insulation below concrete slab-on-grade.

2.3 SPRAYED FOAM INSULATION

- A. Sprayed Polyurethane Foam Sealant for Perimeter of Doors and Windows: 1- or 2-component, foamed-in-place, polyurethane foam sealant, 1.5 to 2.0 lb/cu. ft. density; flame spread index of 25 or less according to ASTM E 162; with primer and noncorrosive substrate cleaner recommended by foam sealant manufacturer.
1. Products:
 - a. Great Stuff Window & Door by Dow

- b. Froth-Pak by Insta-Foam Products, Inc.
 - c. Zerodraft Insulating Air Sealant by Zerodraft.
- B. Foamed-in-Place Insulation: ASTM C 1029, Type II, two-component, spray-in-place, 1.8 to 2.0- lb-density, plastic foam with closed-cell structure, conforming to the following:
- 1. Flame/Smoke Properties: 25/450 in accordance with ASTM E84.
 - 2. R-Value per Inch, Aged: 6.2 minimum.
 - 3. Products:
 - a. Corbond® Performance Insulation System.
 - b. Henry Permax 1.8 Closed Cell Foam Insulation.
 - c. Styrofoam™ SPF Insulation.
 - 4. Application: Where indicated on the drawings.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF BELOW-GRADE INSULATION

- A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.
 - 1. If not otherwise indicated, extend insulation to top of footing.
- 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 24 inches in from exterior walls.

3.3 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Apply foamed-in-place insulation, by spray or froth method to a uniform monolithic density without voids into miscellaneous voids and cavity spaces where shown.

3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072100

SECTION 072616 - BELOW-GRADE VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Vapor retarders under slabs-on-grade.

1.3 DEFINITIONS

- A. Vapor Retarder: Material with a water vapor transmission rating of not over 0.04g per square foot per hour.
- B. Vapor Barrier: Material with a water vapor transmission rating of not over 0.015g per square foot per hour.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: 12 inch square units for each type of vapor retarder, vapor barrier, or air barrier indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

1.6 PROJECT CONDITIONS

- A. Separate and recycle waste materials.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers and Products: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following products listed in Part 2 of this Section.

2.2 VAPOR RETARDERS FOR UNDER SLABS

- A. Vapor Retarder with extremely low permeance for critically sensitive, low permeance floor coverings such as rubber, vinyl, urethane, epoxy and methyl methacrylate, as well as linoleum and wood, having the following qualities:

1. Minimum Permeance: ASTM E-96, not greater than 0.01 perms.
2. Tensile Strength: ASTM E154 or D638, Class A – over 45 lbf/in.
3. Puncture Resistance: ASTM E-154, Class B – over 1700 grams.
4. Water Vapor Barrier: ASTM E-1745, meets or exceeds Class B.
5. Thickness of Barrier (Plastic) ACI 302.1R-96, not less than 15 mils.

- B. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

1. Stego Wrap, 15 mil thick vapor retarder by Stego Industries LLC, (877) 464-7834.
2. Vaporguard by Reef Industries.
3. Sealtight Perminator 15 mil Underslab Vapor-Mat by W.R. Meadows, Inc.
4. Viper VaporCheck 16 by Insulation Solutions, Inc.

- C. Vapor-Retarder Tape (for slabs): Stego Warp red polyethylene tape or tape as recommended by the manufacturer.

- D. Double-Stick Edge Tape: Preformed 1-1/2" wide two-sided adhesive. Available products include "Fab Tape" by Reef Industries.

- E. Expansion Joint Filler: Installer may elect to use Deck-O-Foam Expansion Joint Filler by WR Meadows or equal. Foam expansion joint filler with pre-scored removable strip for installation of joint sealant.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances harmful to vapor retarders, including removing projections capable of puncturing vapor retarders, or of interfering with attachment.
- B. Do not install carpet over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet manufacturer.

3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions applicable to products and application indicated.
- B. Extend retarders in thickness indicated to envelop entire area to be covered. Cut and fit tightly around obstructions. Remove projections that interfere with placement.

3.4 INSTALLATION OF UNDER-SLAB VAPOR RETARDERS

- A. Moisture vapor retarder system shall be installed at all interior floor slabs and as otherwise indicated in the drawings in strict accordance with the manufacturer's printed instructions and as follows:
 1. Snap chalk line along inside perimeter of foundation walls at top of slab elevation.
 2. Without wetting, clean a 3" wide band on the surface of the concrete below the chalk line at approximately mid-slab height. Remove dirt, residual form release, or other bond inhibiting surface contaminants. Grind smooth any surface projections within the band.
 3. While removing the contact paper on the backside, firmly press 2" wide double-stick edge tape onto wall, parallel to the chalk line on the cleaned band at mid-slab elevation.
 4. Remove contact paper on the face side.
 5. Apply a 12" wide strip of vapor retarder covering only the bottom 1" of contact surface on the edge tape. Cut, fit, and seal corner details with vapor retarder seaming tape.
 6. Align top edge of Deck-O-Foam expansion joint material to chalk line, and press material onto remaining 1" of exposed perimeter strip adhesive.
 7. Roll out vapor retarder material, overlapping edge rolls and all seams by 3". Tape all seams with vapor retarder seaming tape.
 8. All tears, punctures, etc. to be repaired and taped as required to maintain the watertight integrity of the vapor retarder system.

3.5 PROTECTION

- A. Protect installed vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where vapor retarders are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 072616

SECTION 211100 - FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

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 fire-suppression water-service piping and related components inside the building, below the floor slab, inclusive of the following:
 - 1. Pipes, fittings, and specialties.
- B. Project scope shall re-feed the existing sprinkler risers via new service as indicated on the contract drawings.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Design sprinkler service and obtain approval from authorities having jurisdiction. The design of the automatic sprinkler service shall be complete with all necessary accessories for proper operation. The contractor shall be responsible for reviewing the original sprinkler design criteria (available through Eyecare Medical Group) and verifying the ability for the new service to provide adequate pressure and flow for the existing service, with regard for proposed building expansion.
- B. The system shall be hydraulically calculated in accordance with all provisions of the Contract Documents and any authority having jurisdiction.
- C. The contract documents do not include a fire pump. Provide over-sized piping as required to meet required system hydraulics. Contractor shall review the civil plans, the existing site and existing fire flow data. If the contractor or authority with jurisdiction determines that a fire pump is required: Provide in accordance with NFPA 20, "Stationary Pumps for Fire Protection," for fire pumps, drivers, controllers, accessories, and their installation.
- D. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction:
 - 1. Include a 5 percent margin of safety for available water flow and pressure.
 - 2. Include losses through water-service piping, valves, and backflow preventers.

1.4 ACTION SUBMITTALS

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

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B. Shop Drawings:

1. Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.
2. Include diagrams for power, signal, and control wiring.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of utility company supplying the water. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with FM Global's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

E. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends and flange faces.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. During Storage: Use precautions for valves, including fire hydrants, according to the following:

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect from weather. Store indoors and maintain temperature higher than ambient dew point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

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- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.7 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Suppression Water-Service Piping: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water-distribution service according to requirements indicated:
 - 1. Notify Architect and Owner no fewer than two days in advance of proposed interruption of service.
 - 2. Do not proceed with interruption of service without Architect's and Owner's written permission.

PART 2 - PRODUCTS

2.1 STEEL PIPE AND FITTINGS

- A. Thinwall Black-Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, threadable, with wall thickness less than Schedule 30 and equal to or greater than Schedule 10. Pipe ends may be factory or field formed to match joining method.
- B. Grooved-Joint, Steel-Pipe Appurtenances:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping System Co.
 - c. National Fittings, Inc.
 - d. Shurjoint Piping Products.
 - e. Tyco Fire & Building Products LP.
 - f. Victaulic Company.
 - 2. Pressure Rating: 175 psig (1200 kPa) minimum.
 - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
 - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.
- C. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig (1200-kPa) pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

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

2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
- B. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end.
- C. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end.
- D. Grooved-End, Ductile-Iron Pipe Appurtenances:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anvil International, Inc.
 - b. Corcoran Piping Systems Inc.
 - c. Shurjoint Piping Products.
 - d. Star Pipe Products.
 - e. Tyco Fire & Building Products LP.
 - f. Venus Fire Protection Ltd.
 - g. Victaulic Company.
 - h. Viking Corporation.
 2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
 3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- E. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
 1. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- F. Push-on-Joint, Ductile-Iron Fittings: AWWA C153, ductile-iron compact pattern.
 1. Gaskets: AWWA C111, rubber.
- G. Flanges: ASME B16.1, Class 125, cast iron.

2.3 ENCASEMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.

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- B. Material: Linear low-density PE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm) minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black or natural.

2.4 JOINING MATERIALS

- A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.
- B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.

2.5 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascade Waterworks Manufacturing.
 - b. Dresser, Inc.; Dresser Piping Specialties.
 - c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
 - d. JCM Industries.
 - e. ROMAC Industries Inc.
 - f. Smith-Blair, Inc.; a Sensus company.
 - g. Viking Johnson.
 - 2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners, and with ends of same sizes as piping to be joined.
 - 3. Standard: AWWA C219.
 - 4. Center-Sleeve Material: Manufacturer's standard.
 - 5. Gasket Material: Natural or synthetic rubber.
 - 6. Pressure Rating: 150 psig (1035 kPa) minimum.
 - 7. Metal Component Finish: Corrosion-resistant coating or material.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with excavating, trenching, and backfilling requirements in Section 312000 "Earth Moving."

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3.2 PIPING INSTALLATION

- A. Extend service from the site service to the existing sprinkler riser.
- B. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
 - 1. Install encasement for piping according to ASTM A 674 or AWWA C105.
- C. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- D. Comply with requirements in Section 221116 "Domestic Water Piping" for potable-water piping inside the building.
- E. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."
- F. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in tubing NPS 2 (DN 50) and smaller.
- C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.
- D. Ream ends of tubes and remove burrs.
- E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.
- F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
- G. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.
- H. Do not use flanges or unions for underground piping.
- I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 ANCHORAGE INSTALLATION

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- A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:
 - 1. Concrete thrust blocks.
 - 2. Locking mechanical joints.
 - 3. Set-screw mechanical retainer glands.
 - 4. Bolted flanged joints.
 - 5. Heat-fused joints.
 - 6. Pipe clamps and tie rods.
- B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
 - 1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
 - 2. Gasketed-Joint, PVC Water-Service Piping: According to AWWA M23.
 - 3. Bonded-Joint Fiberglass, Water-Service Piping: According to AWWA M45.
- C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

3.5 CONNECTIONS

- A. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.6 FIELD QUALITY CONTROL

- A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.
- B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
 - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to zero psig (zero kPa). Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- D. Prepare test and inspection reports.

3.7 CLEANING

- A. Clean and disinfect fire-suppression water-service piping as follows:

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1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
 2. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
 3. Use purging and disinfecting procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in AWWA C651 or do as follows:
 - a. Fill system or part of system with water/chlorine solution containing at least 50 ppm of chlorine; isolate and allow it to stand for 24 hours.
 - b. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 ppm of chlorine; isolate and allow it to stand for three hours.
 - c. After standing time, flush system with clean, potable water until no chlorine remains in water coming from system.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedure if biological examination shows evidence of contamination.
- B. Prepare reports of purging and disinfecting activities.

3.8 PIPING SCHEDULE

- A. Pipe and fittings shall conform to the requirements of NFPA 13. Pipe shall be listed by UL and be FM approved, and installed per its listing and approval.
- B. Above Ground, interior piping: Standard-pressure, wet-pipe sprinkler system, NPS 5 (DN 125) and larger, shall be the following:
 1. Thinwall black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
- C. Underslab fire-suppression water-service piping NPS 6 to NPS 12 (DN 150 to DN 300) shall be the following:
 1. Push-on-joint, ductile-iron pipe; push-on-joint, ductile-iron compact-pattern fittings; and restrained, gasketed joints.

END OF SECTION 211100

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Plumbing Specialties" for water distribution piping specialties.

1.2 SUMMARY

- A. This Section includes domestic water piping from locations indicated to fixtures and equipment inside the building.
- B. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- C. General layout shown, provide piping to fixtures as required by the Maine Plumbing Code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 SUBMITTALS

- A. Product Data: For the following products:
 - 1. Specialty valves.
 - 2. Transition fittings.
 - 3. Dielectric fittings.
 - 4. Flexible connectors.
 - 5. Water meters.
 - 6. Escutcheons.
 - 7. Sleeves and sleeve seals.
 - 8. Water penetration systems.

- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

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- B. Comply with the UPC 2009 edition, subject to the exclusions and amendments set forth by the Maine Plumbers Examining Board.
- C. [Comply with local building and plumbing codes.]
- D. Qualify brazing processes for copper and copper alloy pipe and tube according to ANSI/AWS C3.4.
- E. Comply with NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances," and NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for combined fire-protection and domestic water service piping to building.
- F. Comply with NSF 61, "Drinking Water System Components-Health Effects; Sections 1 through 9," for potable domestic water piping and components.
- G. Water line components shall be lead-free.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.
- B. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- C. Transition Couplings for Underground Pressure Piping: AWWA C219, metal, sleeve-type coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.2 DUCTILE-IRON PIPING

- A. From inside face of exterior wall to a distance of approximately 5 feet outside of building (coordinate with Division 2). Provide flanged and anchored connection to interior piping. Materials shall be approved by the local water utility.
- B. Ductile iron pipe shall meet requirements of AWWA Standard C-151 (latest revision) and be cement lined and seal coated to meet AWWA Standard C-104 (latest revision). Joints shall meet requirements of AWWA C-111 (latest revision). Interior seal coated, bituminous paint oil cut, emulsion not acceptable, thickness minimum of 2 mils dry film thickness. Exterior bituminous coated with minimum of 2 mils dry film thickness. Class 52 wall thickness, 4-inch diameter through 12-inch diameter inclusive. Mechanical joint pipe to be furnished with gland, gaskets and Cor-Ten bolts and nuts.
- C. Ductile Iron Fittings Including Bends, Reducers, Off-Sets, Tees And Sleeves: Material shall be ASTM A536 latest, grade 70-50-05, in accordance with AWWA C153 (latest revision). Fittings

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shall be cement lined AWWA C104 (latest revision) or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116. Interior seal coated AWWA C104 with minimum of 4 mils dry film thickness. Exterior bituminous coated, 4 mils minimum dry film thickness or fusion bonded epoxy coated with a 5 mil nominal thickness per AWWA C550 and C116. Mechanical joint with accessories furnished: D.I. glands, gaskets, Cor-Ten T-bolts and nuts. Pressure Rating: Class 350 pressure rating in accordance with AWWA C153.

2.3 COPPER TUBING

- A. Soft Copper Tube: ASTM B 88, Types K and L, water tube, annealed temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- B. Hard Copper Tube: ASTM B 88, Types L and M, water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
 3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
 4. Copper, Grooved-End Fittings: ASTM B 75 copper tube or ASTM B 584 bronze castings.
 5. Copper-Tubing, Keyed Couplings: Copper-tube dimensions and design similar to AWWA C606. Include ferrous housing sections, gasket suitable for hot water, and bolts and nuts.
- C. Mechanically formed copper or steel tee connections are not acceptable.

2.4 VALVES

- A. Ball Valves
1. The valve body and adapter shall be constructed using Lead Free brass. Lead Free ball valves shall comply with state codes and standards, where applicable, requiring reduced lead content.
 2. ½" to 2" ball valves: 2-piece full port Lead Free brass ball valves: The valve must have a blowout proof pressure retaining 316 stainless steel stem, 316 stainless steel ball, virgin PTFE seats, seals, stem packing seal and thrust washer. Valve must have adjustable packing. Valves with O-ring stem seal only are not acceptable. Pressure rating no less than 600psi WOG non-shock, 150psi WSP. Valve shall be manufactured to the MSS-SP-110 standard and shall be a Watts Series LFB6080 (threaded) or LFB6081 (solder).
 3. Valve sizes 2-1/2" to 4" threaded, shall be rated to 400psi WOG non-shock and 125psi WSP. Valve sizes 2-1/2" to 3" solder shall be rated to 400psi WOG non-shock and 125psi WSP. Valve shall be a Watts Series LFFBV-3C (threaded) or LFFBVS-3C (solder).

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4. Provide locking handle where indicated.
 5. Comply with MSS SP-110.
- B. Swing check valves: Valves shall be manufactured out of Lead Free brass and be pressure rated to 125psi WSP, 200psi WOG non-shock. Valve shall have metal-to-metal seating, tee pattern design and solder end connections. The Lead Free brass check valves shall comply with state codes and standards, where applicable, requiring reduced lead content. Valve shall be a Watts Series LFCVS.
- C. Wafer Check valves:
1. Provide wafer style, butterfly type, spring actuated check valves designed to be installed with gaskets between 2 standard Class 125 flanges. Construct iron body valves with pressure containing parts of valves with materials conforming to ANSI/ASTM A 126, Grade B. Support hanger pin by removable side plug.
 2. 2" and Larger: Class 125, cast iron body, stainless steel trim, bronze disc, Buna-N seal: Nibco W920-W, Stockham WG970, Metraflex C-125, Hammond 9253, Milwaukee 1400, Watts ICV/ICV-F series, or approved equal.
- D. Swing check valves:
1. Construct pressure containing parts of Valves as follows: Bronze Valves: 125 or 150 psi: ANSI/ASTM B 62; Iron Body Valves: ANSI/ASTM A-126, Grade B
 2. Comply with the following standards for design, workmanship, material and testing: Bronze Valves: MSS SP – 80; Cast Iron Valves: MSS SP – 71
 3. Construct valves of pressure casting free of any impregnating materials. Construct disc and hanger as one piece. Support hanger pins by removable side plug.
 4. Threaded Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB904, Nibco T-413B, Stockham B319, Milwaukee 509 or approved equal.
 5. Soldered Ends 2" and Smaller: Class 125, bronze body, screwed cap, Teflon disc: Hammond IB912, Nibco S-413-B, Stockham B309, Milwaukee 1509 or approved equal.
 6. Flanged Ends 2-1/2" and Larger: Class 125, iron body, bronze mounted, horizontal swing, cast-iron disc: Hammond IR1124, Nibco F918-B, Stockham G931, Milwaukee F2974, Watts 411 or approved equal.

PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground piping, unless otherwise indicated. Piping 5" and larger: Grooved joints may be used on aboveground grooved-end piping.
- C. Mechanically formed tee-branch outlets and brazed joints shall not be used.

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- D. Underground Domestic Water Service Piping: Use any of the following piping materials for each size range:
 - 1. NPS 2-1/2 and larger: ductile-iron pipe; mechanical- or push-on-joint, ductile-iron fittings; and restrained, gasketed joints.
- E. Aboveground Domestic Water or Non-Potable Water Piping: Use the following piping materials for each size range:
 - 1. NPS 3 and Smaller: Type L copper.
 - 2. NPS 4 to NPS 6: Type L copper.

3.3 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
 - 1. Shutoff Duty: Use bronze ball valves for piping NPS 3 and smaller. Use cast-iron butterfly valves with flanged or grooved ends for piping NPS 4 and larger.
 - 2. Drain Duty: Hose-end drain valves.

3.4 VALVE INSTALLATION

- A. Install sectional valve close to water main on each branch and riser serving plumbing fixtures or equipment.
- B. Install shutoff valve on each water supply to equipment and on each water supply to plumbing fixtures without supply stops.
- C. Install hose end drain valves for equipment, at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
- D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Refer to Division 22 Section "Plumbing Specialties" for calibrated balancing valves.

3.5 PIPING INSTALLATION

- A. Extend domestic water service piping to exterior water distribution piping in sizes and locations indicated.
- B. Install underground ductile-iron piping according to AWWA C600 and NFPA 24.
- C. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside building at each domestic water service.

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- E. Provide dielectric fittings as specified in Section 230500.
- F. Install aboveground domestic water piping level and plumb.
- G. Fill water piping. Check components to determine that they are not air bound and that piping is full of water.
- H. Perform the following steps before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
 - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
- I. Check plumbing equipment and verify proper settings, adjustments, and operation. Do not operate water heaters before filling with water.
- J. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.6 JOINT CONSTRUCTION

- A. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump. Domestic water temperature maintenance pumps do not require flexible connectors.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to service piping with shutoff valve, and extend and connect to the equipment and fixtures as shown on the plans.
- E. Connect water piping in sizes indicated, but not smaller than sizes of unit connections.
- F. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

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3.9 FIELD QUALITY CONTROL

- A. Follow local code requirements.
- B. Inspect domestic water piping as follows:
 - 1. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - 2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - 3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- C. Test domestic water piping as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced domestic water piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 4. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
 - 5. Prepare reports for tests and required corrective action.

3.10 CLEANING

- A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses. Clean and disinfect domestic water piping per code requirements or administrative authority requirements. Sample procedure as indicated:
 - 1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:

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- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
- b. Fill and isolate system according to either of the following: Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours. Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
- c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
- d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 221116

SECTION 221119 - PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes plumbing specialties.

1.3 PERFORMANCE REQUIREMENTS

- A. Provide components and installation capable of producing piping systems with following minimum working-pressure ratings, unless otherwise indicated:
 - 1. Domestic Water Piping: 125 psig.
 - 2. Sanitary Waste and Vent Piping: 10-foot head of water.
 - 3. Storm Drainage Piping: 10-foot head of water.

1.4 ACTION SUBMITTALS

- A. Product Data: Include rated capacities and shipping, installed, and operating weights. Indicate materials, finishes, dimensions, required clearances, and methods of assembly of components; and piping and wiring connections.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data
- B. Field test reports.

1.6 QUALITY ASSURANCE

- A. Plumbing specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with the UPC 2009 edition, subject to the exclusions and amendments set forth by the Maine Plumbers Examining Board.

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- D. [Comply with local building and plumbing codes.]
- E. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for piping materials and installation.
- F. Water line components shall be lead-free.
- G. NSF Compliance: Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components. Include marking "NSF-pw" on plastic potable-water piping and "NSF-dwv" on plastic drain, waste, and vent piping. Comply with NSF 61, "Drinking Water System Components--Health Effects, Sections 1 through 9," for potable domestic water plumbing specialties.

PART 2 - PRODUCTS

2.1 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

2.2 CLEANOUTS

A. Manufacturers

1. Zurn
2. Smith, Jay R. Mfg. Co.
3. Josam Co.
4. Tyler Pipe, Wade Div.
5. Watts Industries, Inc., Drainage Products Div.
6. Mifab

- B. Cleanouts shall be easily accessible and shall be gastight and watertight. Provide a minimum clearance of 24 inches for the rodding. Size of cleanout shall be same as pipe size through 4". Pipes 4" and larger shall have 4" cleanouts.

- C. Floor Cleanouts: Mifab C1000 Series floor cleanout with heavy-duty nickel-bronze or stainless steel adjustable top.

1. Compliance: ANSI/ASME A112.36.2M.
2. Load Rating: Up to 7,499 pounds.
3. Body: A1, 8-inch diameter body. Lacquered, ASTM A 48, Class 25 cast iron body with anchor flange. O-ring secondary gasket seal. 4-inch; 4"NPS machined integral body threads.
4. Combined Access Cover and Plug Top Assembly: Heavy-duty, round, 5-inch diameter; square, 5-inch by 5-inch (for tile insertion), adjustable, Type 304 stainless steel top assembly with No. 4 satin finish. Neoprene primary gasket seal. Vandal-resistant stainless steel screws.
5. When a waterproof membrane is used in the floor system, provide clamping collars on the cleanouts.
6. In carpeted areas, provide carpet cleanout markers.

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- D. Cleanouts shall consist of "Y" fittings and (1/8 inch) bends with brass or bronze screw plugs.
- E. Provide cleanouts at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack Cleanout shall consist of sanitary tees. . Extend the cleanouts to the wall access cover; Mifab 1400 Series.
- F. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.3 FLOOR DRAINS

- A. Manufacturers
 - 1. Zurn Industries, Inc
 - 2. Jay R. Smith Mfg. Co.
 - 3. Tyler Pipe, Wade Div.
 - 4. Watts Industries, Inc
 - 5. Mifab
- B. Floor drains shall comply with ASME A112.21.1M.
- C. Provide outlet type as required by piping system used.
- D. Provide ½” trap primer connection as indicated on plans.
- E. FFD-1: Condensate Floor Funnel Drain: Zurn Z550-Y w/Z329-9 funnel converting assembly; dura-coated cast iron body, 9” round nickel bronze rim and grate, and 8-7/8” x 3-5/8” x 3-3/4” high funnel, Sediment bucket.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to hydronic systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
 - 3. Do not install bypass piping around backflow preventers.

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4. Access shall be provided for testing, maintenance and repair. Locate backflow preventer between 2 feet and 5 feet above floor.
 5. Test of Backflow Prevention Assemblies: Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research or the American Water Works Association Manual of Cross Connection (Manual M-14). Report form for each assembly shall include, as a minimum, the following:
 - a. Data on Device Data on Testing Firm
 - b. Type of Assembly Name
 - c. Manufacturer Address
 - d. Model Number Certified Tester
 - e. Serial Number Certified Tester No.
 - f. Size Date of Test
 - g. Location
 - h. Test Pressure Readings Serial Number and Test Data of Gauges
 - i. If the unit fails to meet specified requirements, the unit shall be repaired and retested.
- C. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- D. Install pressure regulators with inlet and outlet shutoff valves and balance valve bypass. Install pressure gages on inlet and outlet.
- E. Install strainers on supply side of each control valve, pressure regulator, and solenoid valve.
- F. Cleanouts:
1. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated: Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated. Locate at each change in direction of piping greater than 45 degrees. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping. Locate at base of each vertical soil and waste stack.
 2. Install cleanout deck plates with top flush with finished floor, for floor cleanouts for piping below floors.
 3. Install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall, for cleanouts located in concealed piping.
 4. Install flashing flange and clamping device with each stack and cleanout passing through floors with waterproof membrane.
- G. Install floor drains in accordance with manufacturer's instructions at locations indicated on the drawings.
1. Protect installed floor drains from damage during construction.
 2. Install floor drains at low points of surface areas to be drained.
 3. Install floor drains plumb, level, and to correct elevation.
 4. Ensure top of floor drains are flush with top of finished floor.
 5. Install floor drains using manufacturer's supplied hardware.

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6. Coordinate depressed/pitched slab with concrete contractor.
7. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
8. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

3.2 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to AWWA M6 and utility's requirements.
- B. Install roughing-in piping and specialties for water meter installation according to utility's instructions and requirements.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect plumbing specialties to piping specified in other Division 22 Sections.
- D. Connect plumbing specialties and devices that require power according to Electrical Specification Sections.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221119

SECTION 221316 – PLUMBING SANITARY AND STORM PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Division 22 Section "Plumbing Specialties" for soil, waste, and vent piping systems specialties.

1.2 SUMMARY

- A. This Section includes soil and waste, sanitary drainage and vent piping inside the building and to locations indicated.
- B. This Section includes storm-drainage piping inside the building and to locations indicated.
- C. Drawings show the general layout of piping and accessories but do not show all required fittings and offsets that may be necessary to connect piping to equipment and to coordinate with other trades. Fabricate piping based on field measurements. Provide all necessary fittings and offsets.
- D. General layout shown, provide piping to fixtures as required by the Maine Plumbing Code. A licensed master plumber shall perform or supervise the work and provide layouts, piping, and fittings as required by code.

1.3 PERFORMANCE REQUIREMENTS

- A. Comply with the utility requirements for the connection of to the municipal utility services. Obtain and pay for all necessary permits from the applicable municipal department. Obtain authority to connect to their existing mains.
- B. Provide components and installation capable of producing piping systems with working-pressure ratings per local plumbing code.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

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1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with the UPC 2009 edition, subject to the exclusions and amendments set forth by the Maine Plumbers Examining Board.
- C. [Comply with local building and plumbing codes.]
- D. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.2 CAST-IRON SOIL PIPING

A. Hubless

- 1. Hubless Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-888 and CISPI Standard 301. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.
- 2. Hubless couplings shall conform to CISPI Standard 310 for standard couplings or ASTM C-1540 for heavy duty couplings where indicated. Gaskets shall conform to ASTM C-564. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements. Couplings shall be installed in accordance with the manufacturer's band tightening sequence and torque. Tighten bands with a properly calibrated torque limiting device.

B. Hub and Spigot Cast Iron Soil Pipe and Fittings:

- 1. Hub and Spigot Cast Iron pipe and fittings shall be manufactured from gray cast iron and shall conform to ASTM A-74. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute. Pipe and fittings to be Service (SV) Extra Heavy (XH)
- 2. Joints can be made using a compression gasket manufactured from a neoprene elastomer meeting the requirements of ASTM C-564 or lead and oakum. All pipe and fittings to be produced by a single manufacturer and are to be installed in accordance with manufacturer's recommendations and local code requirements. The system shall be hydrostatically tested after installation to 10 ft. of head (4.3 psi maximum).

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2.3 PVC DRAINAGE PIPING

- A. Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785 and ASTM D-2665. Fittings shall conform to ASTM D-2665.
- B. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D-2564, primer shall conform to ASTM F-656. The system to be manufactured by Charlotte Pipe and Foundry Co. or approved equal; and shall be intended for non-pressure drainage applications where the temperature will not exceed 140°F.

2.4 PVC PRESSURE PIPING

- A. All pipe and fittings to be produced by a single manufacturer and to be installed in accordance with manufacturer's recommendations and local code requirements. Solvent cements shall conform to ASTM D-2564, primer shall conform to ASTM F-656. The system to be manufactured by Charlotte Pipe and Foundry Co. and is intended for pressure applications where the temperature will not exceed 140°F.
- B. Solid Wall: Pipe and fittings shall be manufactured from PVC compound with a cell class of 12454 per ASTM D-1784 and conform with National Sanitation Foundation (NSF) standards 14 and 61. Pipe shall be iron pipe size (IPS) conforming to ASTM D-1785. Fittings shall conform to ASTM D-2466.
- C. Foam Core: Pipe and fittings shall be manufactured from PVC compound with a cell class of 11432 per ASTM D-4396 for pipe and 12454 per ASTM D-1784 for fittings and conform with National Sanitation Foundation (NSF) standard 14. Pipe shall be iron pipe size (IPS) conforming to ASTM F-891. Fittings shall conform to ASTM D-2665.

2.5 FIRESTOP PROTECTION FOR DWV AND STORMWATER PIPING

- A. All piping penetrations of fire-resistant rated construction shall be protected in accordance with the plumbing code.
- B. Use ProSet, or approved equal, "Firestop Penetrators", Warnock Hersey classified and listed in the building materials directory.
- C. Products shall be tested in accordance with the ASTM E-814 standards and shall be selected for all applicable pipe penetrations and plumbing fixture floor openings through Fire-Rated floors, walls or floor/ceiling assemblies, in accordance with the Manufacturer's instructions.
 - 1. Use ProSet System "B" penetrators for cast iron DWV pipes for stacks and drains penetrating floors and walls.
 - 2. Use ProSet System "C" penetrators for plastic DWV pipes for stacks and drains penetrating floors and walls

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PART 3 - EXECUTION

3.1 EXCAVATION

- A. Refer to Division 31 for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground and Underground, Soil, Waste, and Vent Piping: Use any of the following piping materials for each size range:

- 1. Cast iron

- a. Risers/stacks
- b. Autoclave Floor drains – within 10 feet of drains
- c. Exposed to finished space

- 2. PVC or Cast iron

- a. Under slab
- b. Concealed
- c. Vents

- D. Vent Piping through roof/exposed above roof: Use any of the following piping materials for each size range:

- 1. Cast iron
- 2. Schedule 40 PVC DWV
- 3. ABS

- E. Elevator sump pump discharge piping: Type L sweated copper.

- F. Storm Drain Piping:

- 1. Cast iron
- 2. Schedule 40 PVC DWV

- G. Storm Drain Piping, heat traced: Cast iron

3.3 PIPING INSTALLATION

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.
- B. Install cleanouts at grade and extend to where building drains connect to site piping.

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- C. Install cleanout fitting with closure plug inside the building in force-main piping.
- D. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Refer to Division 22 Section "Common Work Results for Plumbing" for wall penetration systems.
- E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- F. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.
- G. Install underground PVC soil and waste drainage piping according to ASTM D 2321.
- H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- J. Install drainage and vent piping at the minimum slopes as required by the local plumbing code.
- K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- L. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings." Gasketed Joints: Make with rubber gasket matching class of pipe and fittings. Hubless Joints: Make with rubber gasket and sleeve or clamp.

3.5 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

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- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials. Connect storm drainage piping to roof drains and storm drainage specialties.
- C. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials. Connect drainage and vent piping to fixtures and equipment as shown on the plans. Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

3.6 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Test piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 3. Roughing-in Plumbing Test Procedure: Test piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
 - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
 - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and

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allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- D. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- E. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

3.7 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

SECTION 221429 - SUMP PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes:
 - 1. Sump pumps for elevator sump pits.

1.3 SUBMITTALS

- A. Product Data: Include performance curves, furnished specialties, and accessories for each type and size of pump indicated.
- B. Shop Drawings: Show layout and connections for pumps. Include setting drawings with templates, directions for installing foundation and anchor bolts, and other anchorages.
- C. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring.
- D. Maintenance Data: For each type and size of pump specified to include in maintenance manuals specified in Division 1.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, connections, and dimensional requirements of pumps and are based on specific manufacturer types and models indicated. Other manufacturers' pumps with equal performance characteristics may be considered.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Retain shipping flange protective covers and protective coatings during storage.
- B. Protect bearings and couplings against damage.
- C. Comply with pump manufacturer's rigging instructions for handling.

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PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Weil Pump Co.
 2. Little Giant Pump Co.
 3. Weil Pump Co.
 4. Zoeller Pump Co.
 5. Liberty Pumps.
 6. Myers
 7. Stancor

2.2 SUMP PUMPS, GENERAL

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested units before shipping.
- B. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembling and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

2.3 ELEVATOR SUMP PUMP

- A. Description: Zoeller Oil Guard System submersible, direct-connected sump pump.. Approved equal: Liberty or ABS.
1. Casing: Cast iron with metal inlet strainer, stainless steel handle. Include discharge companion flange suitable for plain-end pipe connection arranged for vertical discharge.
 2. Impeller: Cast iron, bronze, brass, or stainless steel.
 3. Pump and Motor Shaft: Steel, with factory-sealed, grease-lubricated ball bearings.
 4. Seal: ceramic carbon.
 5. Motor: Hermetically sealed capacitor-start type; with built-in overload protection; and three-conductor waterproof power cable of length required, with grounding plug and cable-sealing assembly for connection at pump.
 6. Automatic reset thermal overload protected.
 7. Pump Discharge Piping: 1 ½" Factory or field fabricated, ASTM A 53, Schedule 40, galvanized-steel pipe or copper tube.
 8. Oil smart switch and alarm features:
 - a. Audible and Light alarms with dry contacts.
 - b. NEMA 4X watertight panel enclosure with lockable latch
 - c. Preset "On and off" points; UL508 approved switch.
 - d. Differentiates oil and water; 304-SS probes.
 - e. Alert maintenance personnel of high water or oil detection.
 - f. 20 foot piggyback electrical supply cord

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- g. 20 amp relay.
 - h. NEMA 3R alarm enclosure.
- B. Sump Pump Pits
- a. Topp Industries, Inc Elevator Poly Basin Model B1824ELE.
 - b. 18"x24; 24 gallons.
 - c. Cover designed for quick water runoff with perforations; ¼" steel thick cover; 1-1/2" discharge flange, cord grommet, and hardware pack.
 - d. Rotational-molded polyethylene; 3/16" wall thickness.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of plumbing piping systems to verify actual locations of piping connections before pump installation.

3.2 INSTALLATION

- A. Install pumps according to manufacturer's written instructions.
- B. Install pumps and arrange to provide access for maintenance, including removal of motors, impellers, couplings, and accessories.
- C. Support piping so weight of piping is not supported by pumps.
- D. Sump Pump Basins: Install basins and connect to storm drainage piping. Brace interior of basins according to manufacturer's written instructions to prevent distortion or collapse during concrete placement. Set basin cover and fasten to basin top flange. Install so top surface of cover is flush with finished floor.

3.3 CONNECTIONS

- A. Install discharge pipe sizes equal to or greater than diameter of pump nozzles, and connect to storm drainage piping.
- B. Install swing check valve and ball valve on each pump discharge.
- C. Install electrical connections for power, controls, and devices.
- D. Electrical power and control components, wiring, and connections are specified in Electrical Specification Sections.
- E. Ground equipment. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B

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3.4 ADJUSTING

1. Pump Controls: Set pump controls for automatic start, stop, and alarm operation as required for system application.

3.5 COMMISSIONING

A. Final Checks before Starting: Perform the following preventive maintenance operations:

1. Lubricate bearings.
2. Disconnect couplings and check motors for proper direction of rotation.
3. Verify that each pump is free to rotate by hand. Do not operate pump if it is bound or drags, until cause of trouble is determined and corrected.
4. Verify that pump controls are correct for required application.

B. Starting procedure for pumps with shutoff power not exceeding safe motor power is as follows:

1. Start motors.
2. Open discharge valves slowly.
3. Check general mechanical operation of pumps and motors.
4. Confirm that alarm contact signals control system upon failure or high water level.

END OF SECTION 221429

SECTION 260100 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes:
 - 1. General requirements applicable to all Division 26 sections.
 - 2. Temporary power and lighting.
 - 3. Allowances for Utility Construction Charges.

1.3 TEMPORARY POWER AND LIGHTING

- A. Provide a separately metered temporary electrical service for the construction area.
- B. Power Distribution: Provide weatherproof, grounded circuits with ground-fault interruption features, with proper power characteristics and either permanently wired or plug-in connections as appropriate for intended use. Provide overload-protected disconnect switch for each circuit at distribution panel. Space 4-gang convenience outlets (20 amp circuit) so that every portion of work can be reached with 100' extension cord.
- C. Temporary Lighting: Provide lighting of intensity and quality sufficient for proper and safe performance of the work and for access thereto and security thereof, minimum average illumination level in every room shall be 20 footcandles.

1.4 ALLOWANCES FOR UTILITY CONSTRUCTION CHARGES

- A. Provide a \$12,000 allowance for electric utility company utility construction charges for electrical services as specified in Division 01

1.5 GENERAL REQUIREMENTS APPLICABLE TO ALL DIVISION 26 SECTIONS

- A. Regulatory Requirements:
 - 1. Conform to the requirements of all laws and regulations applicable to the work.
 - 2. Conform to the requirements of Federal State and Municipal Building Codes.
 - 3. Cooperate with all authorities having jurisdiction.

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4. Compliance with laws and regulations governing the work on this project does not relieve the Contractor from compliance with more restrictive requirements contained in these specifications.
5. If the Contract Documents are found to be at variance with any law or regulation, the Contractor shall notify the Architect/Engineer promptly in writing. The Contractor shall assume full responsibility for any work contrary to law or regulation, and shall bear all costs for the corrections thereof.
6. Minimum Requirements: The National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), the National Fire Codes, and National Fire Protection Association (NFPA) are a minimum requirement for work under this section. Design drawings and other specification sections shall govern in those instances where requirements are greater than those required by code.

B. REFERENCES

1. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
 - a. National Fire Protection Association (NFPA).
 - b. National Electrical Code (NEC)
 - c. National Electrical Safety Code (NESC)
 - d. Underwriters Laboratories, Inc. (UL)
 - e. American National Standards Institute (ANSI)
 - f. Certified Ballast Manufacturers Association (CBM)
 - g. National Electrical Manufacturers Association (NEMA)
 - h. International Municipal Signal Association (IMSA)
 - i. Institute of Electrical and Electronic Engineers (IEEE)
 - j. American Society for Testing Materials Specifications (ASTM)
 - k. National Bureau of Standards Handbook (NBS)
 - l. Occupational Safety and Health Administration (OSHA)
 - m. Americans with Disabilities Act (ADA)
 - n. Insulated Power Cable Engineers Association Specifications (IPCEA)

C. Permits, Fees, and Inspections:

1. Secure and pay for all permits, fees, licenses, inspections, etc., required for the work under Division 26.
2. Schedule and pay for all legally required inspections and cooperate with inspecting officers.
3. Provide Certificates of Inspection and Approval from all regulatory authorities having jurisdiction over the work in Division 26.

- D. The Contractor shall study all drawings and specifications, visit the site, and acquaint itself with the existing conditions and the requirements of the plans and specifications. No claim will be recognized for extra compensation due to the failure of the Contractor to familiarize itself with the conditions and extent of the proposed work.

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- E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- F. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

1.6 EFFICIENCY MAINE

- A. This project intends to pursue Efficient Maine (EM) prescriptive and/or custom incentives. The contractor shall participate in the activities associated with Efficiency Maine incentive approval process including but not limited to; preparation and submission of required incentive application(s) and the tracking and submission of measure specific invoices to Efficiency Maine within 60 days of the completion of the work.
- B. The contractor shall also:
 - 1. Become familiar with the Efficiency Maine Business Program including available incentives and the application and review process.
 - 2. Review plans and specifications for compliance with Efficiency Maine standards for applicable systems and technologies.
 - 3. Review plans and specifications for any and all incentive opportunities, prescriptive and custom.
- C. The project schedule shall reflect and accommodate the time required to achieve application preapproval from EM. No equipment shall be purchased until preapproval is received from EM.
- D. All invoices shall be forwarded to EM within 60 days of the completion of work. This deliverable shall be shown on the project schedule as a milestone date and coordinated with all contractors to assure compliance with this requirement.
- E. Efficiency Maine is available to assist in the application process and can be reached at 866-376-2463

1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

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- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION – Not Used

END OF SECTION 260100

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Building wires and cables rated 600 V and less.
- 2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

- 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
- 2. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. [Alcan Products Corporation; Alcan Cable Division.](#)
 - 2. [Alpha Wire.](#)
 - 3. [Belden Inc.](#)
 - 4. [Encore Wire Corporation.](#)
 - 5. [General Cable Technologies Corporation.](#)
 - 6. [Southwire Incorporated.](#)

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- B. Aluminum and Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2, Type XHHW-2 and Type SO.
- D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC; metal-clad cable, Type MC and Type SO with ground wire.

2.2 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. [Hubbell Power Systems, Inc.](#)
 - 2. [Ideal Industries, Inc.](#)
 - 3. [IlSCO](#); a branch of Bardes Corporation.
 - 4. [NSi Industries LLC.](#)
 - 5. [O-Z/Gedney](#); a brand of the EGS Electrical Group.
 - 6. [3M](#); Electrical Markets Division.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper for feeders smaller than No. 1 AWG; copper or aluminum for feeders No. 1 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for or stranded for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.

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- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- D. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- E. Branch Circuits Concealed in Ceilings, Walls, and Partitions:
 - 1. Type THHN-2-THWN-2, single conductors in raceway
 - 2. Hospital-grade armored cable, Type HCF-AC or hospital-grade metal-clad cable, Type HCF-MC for receptacle circuits.
 - 3. Metal-clad cable, Type MC for lighting circuits.
- F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

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3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07.

3.7 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and emergency system feeder conductors for compliance with requirements.
 - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
- B. Test and Inspection Reports: Prepare a written report to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes grounding and bonding systems and equipment.
- B. Section includes grounding and bonding systems and equipment, plus the following special applications:
 - 1. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Ground rods.
 - 2. Grounding arrangements and connections for separately derived systems.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. [Burndy; Part of Hubbell Electrical Systems.](#)
 2. [ERICO International Corporation.](#)
 3. [ILSCO.](#)
 4. [O-Z/Gedney; A Brand of the EGS Electrical Group.](#)

2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
1. Solid Conductors: ASTM B 3.
 2. Stranded Conductors: ASTM B 8.
 3. Tinned Conductors: ASTM B 33.
 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch (6 mm)** in diameter.
 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, **1/4 by 4 inches (6.3 by 100 mm)** in cross section, with **9/32-inch (7.14-mm)** holes spaced **1-1/8 inches (28 mm)** apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

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- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless -type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m)

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 24 inches (600 mm) below grade.
- C. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
- D. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except as otherwise indicated.
 - 3. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Comply with NEC Article 250.

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3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are **2 inches (50 mm)** below finished floor or final grade unless otherwise indicated.
 - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:
 - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

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3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- F. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 feet (18 m)** apart.
- G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; use a minimum of **20 feet (6 m)** of bare copper conductor not smaller than No. 4 AWG.
 1. If concrete foundation is less than **20 feet (6 m)** long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.6 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 2. Prepare dimensioned Drawings locating each ground rod and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- B. Grounding system will be considered defective if it does not pass tests and inspections.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Surface raceways.
5. Boxes, enclosures, and cabinets.
6. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
 - 1.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.

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PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. [Allied Tube & Conduit; a Tyco International Ltd. Co.](#)
 2. [Anamet Electrical, Inc.](#)
 3. [Electri-Flex Company.](#)
 4. [O-Z/Gedney; a brand of EGS Electrical Group.](#)
 5. [Robroy Industries.](#)
 6. [Thomas & Betts Corporation.](#)
 7. [Wheatland Tube Company; a division of John Maneely Company.](#)
- B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
 2. Fittings for EMT:
 - a. Material: Steel.
 - b. Type: Setscrew or compression.
 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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

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1. [AFC Cable Systems, Inc.](#)
 2. [Anamet Electrical, Inc.](#)
 3. [CANTEX Inc.](#)
 4. [CertainTeed Corp.](#)
 5. [Kraloy.](#)
 6. [Lamson & Sessions; Carlon Electrical Products.](#)
 7. [RACO; a Hubbell company.](#)
 8. [Thomas & Betts Corporation.](#)
- B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. ENT: Comply with NEMA TC 13 and UL 1653.
- D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. [Cooper B-Line, Inc.](#)
 2. [Hoffman; a Pentair company.](#)
 3. [Mono-Systems, Inc.](#)
 4. [Square D; a brand of Schneider Electric.](#)
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Screw-cover type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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- B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
1. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Mono-Systems, Inc.
 - b. Panduit Corp.
 - c. Wiremold / Legrand.

2.5 BOXES, ENCLOSURES, AND CABINETS

- A. **Manufacturers:** Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Adalet.
 2. Hoffman; a Pentair company.
 3. Milbank Manufacturing Co.
 4. RACO; a Hubbell Company.
 5. Thomas & Betts Corporation.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Metal Floor Boxes:
1. Material: Cast metal or sheet metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing **50 lb (23 kg)**. Outlet boxes designed for attachment of luminaires weighing more than **50 lb (23 kg)** shall be listed and marked for the maximum allowable weight.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: **4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)**.
- I. Gangable boxes are allowed.

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- J. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- K. Cabinets:
1. NEMA 250, Type 1 galvanized-steel box unless otherwise indicated with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 2. Hinged door in front cover with flush latch and concealed hinge.
 3. Key latch to match panelboards.
 4. Metal barriers to separate wiring of different systems and voltage.
 5. Accessory feet where required for freestanding equipment.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Armorcast Products Company](#).
 - b. [Carson Industries LLC](#).
 - c. [CDR Systems Corporation; Hubbell Power Systems](#).
 - d. [NewBasis](#).
 - e. [Oldcastle Precast, Inc.; Christy Concrete Products](#).
 - f. [Synertech Moulded Products; a division of Oldcastle Precast, Inc.](#)
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC."
7. Handholes **12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)** and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.7 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed Conduit: GRC or IMC.
 2. Concealed Conduit, Aboveground: EMT.
 3. Underground Conduit: RNC, Type EPC-40-PVC for non-emergency circuits, Type EPC-80-PVC for emergency circuits, direct buried unless otherwise indicated.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC
 5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
- B. Indoors: Apply raceway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: EMT.
 2. Exposed and Subject to Severe Physical Damage: GRC.
 3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 5. Damp or Wet Locations: IMC.
 6. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.
 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

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- F. Install surface raceways only where existing construction does not permit wiring to be concealed. Obtain Architect's written permission before installing surface metal raceways.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- I. Raceways Embedded in Slabs:
 - 1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.
 - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 - 5. Change from RNC to GRC or IMC before rising above floor or grade and at changes in direction greater than 10 degrees.
- J. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for raceways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

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- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to **1-1/4-inch (35mm)** trade size and insulated throat metal bushings on **1-1/2-inch (41-mm)** trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- N. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits **2-inch (53-mm)** trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- Q. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- R. Surface Raceways:
 - 1. Install surface raceway with a minimum **2-inch (50-mm)** radius control at bend points.
 - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- S. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- U. Expansion-Joint Fittings:
 - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed **30 deg F (17 deg C)** and that has straight-run length that exceeds **25 feet (7.6 m)**. Install in each run of aboveground RMC and EMT conduit that is located

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- where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.
 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.
 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- V. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations.
- W. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- X. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- Y. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- Z. Locate boxes so that cover or plate will not span different building finishes.
- AA. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- CC. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 for pipe less than **6 inches (150 mm)** in nominal diameter.
2. Install backfill as specified in Division 31.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31.
4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete for a minimum of **12 inches (300 mm)** on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
5. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch (12.5-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures **1 inch (25 mm)** above finished grade.
- D. Install handholes with bottom below frost line.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

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3.5 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Division 07.

3.6 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Identification for conductors.
 - 2. Underground-line warning tape.
 - 3. Warning labels and signs.
 - 4. Instruction signs.
 - 5. Equipment identification labels.
 - 6. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

- A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

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- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the conductor diameter such that the clear shield overlaps the entire printed legend.
- C. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- E. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- F. Write-On Tags: Polyester tag, 0.015 inch (0.38 mm) thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

2.2 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 - 4. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
 - 5. Thickness: 4 mils (0.1 mm).
 - 6. Weight: 18.5 lb/1000 sq. ft. (9.0 kg/100 sq. m).

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7. **3-Inch (75-mm)** Tensile According to ASTM D 882: **30 lbf (133.4 N)**, and **2500 psi (17.2 MPa)**.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: **ELECTRIC LINE, HIGH VOLTAGE,**.
3. Inscriptions for Orange-Colored Tapes: **TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE,**.

2.3 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. **1/4-inch (6.4-mm)** grommets in corners for mounting.
3. Nominal size, **7 by 10 inches (180 by 250 mm)**.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch (1-mm)** galvanized-steel backing; and with colors, legend, and size required for application.
2. **1/4-inch (6.4-mm)** grommets in corners for mounting.
3. Nominal size, **10 by 14 inches (250 by 360 mm)**.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: **"DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."**

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch (1.6 mm)** thick for signs up to **20 sq. inches (129 sq. cm)** and **1/8 inch (3.2 mm)** thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

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- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch (10 mm)**. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.5 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be **3/8 inch (10 mm)**.

2.6 CABLE TIES

- A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.
 - 1. Minimum Width: **3/16 inch (5 mm)**.
 - 2. Tensile Strength at **73 deg F (23 deg C)**, According to ASTM D 638: **12,000 psi (82.7 MPa)**.
 - 3. Temperature Range: **Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C)**.
 - 4. Color: Black except where used for color-coding.

2.7 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

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- F. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
 - 1. Outdoors: UV-stabilized nylon.
 - 2. In Spaces Handling Environmental Air: Plenum rated.

- G. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches (150 to 200 mm)** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds **16 inches (400 mm)** overall.

3.2 IDENTIFICATION SCHEDULE

- A. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
 - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches (150 mm)** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

- B. Power-Circuit Conductor Identification, More than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic plastic tag holder with adhesive-backed phase tags, and a separate tag with the circuit designation.

- C. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

- D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.

- E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.

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- F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum **3/8-inch- (10-mm-)** high letters for emergency instructions at equipment used for power transfer.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with **1/2-inch- (13-mm-)** high letters on **1-1/2-inch- (38-mm-)** high label; where two lines of text are required, use labels **2 inches (50 mm)** high.

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- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
 - c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
2. Equipment to Be Labeled:
- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - e. Emergency system boxes and enclosures.
 - f. Enclosed switches.
 - g. Enclosed circuit breakers.
 - h. Enclosed controllers.
 - i. Push-button stations.
 - j. Power transfer equipment.
 - k. Contactors.
 - l. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 311000 – SITE CLEARING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Protecting existing trees shrubs groundcovers plants and grass to remain.
2. Removing existing trees shrubs groundcovers plants and grass.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.
5. Disconnecting and capping or sealing site utilities.
6. Temporary erosion and sedimentation control measures including phasing as may be required by the Erosion Control Plan.
7. Filing appropriate paperwork with the Maine Department of Forestry for clearing operations.
8. Survey and flagging of all areas for clearing.
9. Reviewing clearing limits with the Owner and Landscape Engineer before commencing clearing operations.

1.2 MATERIAL OWNERSHIP

A. Except for stripped screened topsoil or other materials indicated to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.3 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
 - 1. Notify Owner.
 - 2. Walk clearing limit lines with Owner, adjust if requested by Owner or Landscape Engineer.
- C. Protect existing site improvements to remain from damage during construction.
 - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to the sediment and erosion control plan for the project
- B. Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE PROTECTION

- A. Erect and maintain temporary fencing around tree protection zones before starting site clearing. Remove fence when construction is complete.
- B. Do not excavate within tree protection zones, unless otherwise indicated.
- C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Landscape Engineer.

3.4 UTILITIES

- A. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed.
 - 1. Arrange with utility companies to shut off indicated utilities.

3.5 CLEARING AND GRUBBING

- A. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
 - 1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches (200 mm), and compact each layer to a density equal to adjacent original ground.

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3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
- C. Screen and stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust. Surround perimeter of stockpile with silt fence, eco-logs, or woodchip windows.

3.7 SITE IMPROVEMENTS

- A. Remove existing site improvements that will not be incorporated into the completed project (refer to contract drawings).

3.8 DISPOSAL

- A. Disposal: Remove unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, stumps and cleared material, and legally dispose of them off Owner's property. Burn on site or chip and use for erosion control mulch.
 - 1. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.
 - 2. All topsoil shall be screened. Excess topsoil, if any, shall remain the property of the Owner. The location for stockpile material shall be agreed upon with the Owner.

END OF SECTION 311000

SECTION 312000 – EARTH MOVING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Preparing subgrades for the building slabs-on-grade, walks, pavements, lawns, grasses, ponds, water quality units, and all other subgrade surfaces required for this project.
2. Building pad preparation. The work of this Contract includes the building pad preparation, the excavation and backfill of foundations, footings, floor slabs, and underslab utilities for the Building.
3. Subbase course for walks and pavements.
4. Subbase and base course for asphalt paving.
5. Excavating and backfilling for utility trenches.

1.2 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Course placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Course placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Course supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions changes in the Work.
2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Engineer. Unauthorized excavation, as well as remedial work directed by Engineer, shall be without additional compensation.
3. All excavation including rock is unclassified.

- G. Fill: Soil materials used to raise existing grades.
- H. Impermeable Liner Material: A material to restrict seepage and protect underlying groundwater to prevent seepage.
- I. Rock Fill: Processed rock material (not permitted in building pad or building zone of influence).
- J. 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.
- K. Subbase Course: Course placed between the subgrade and base course for hot-mix asphalt pavement, or course placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.
- N. Zone of Influence (ZOI): The area below footings and below imaginary lines that extend 2 ft laterally beyond the footing outer bottom edges and down on a 1H:1V slope to suitable bearing material.
- O. ABC Material: On-site material that was crushed for re-use as aggregate. Some deleterious material (wood or metal) remains and shall be removed and disposed of during placement of the material in 3 inch loose lifts and prior to compaction. Bid documents must include line item for removal of wood debris from crushed masonry-brick stockpile. Anticipate crushed concrete pile will not have deleterious materials.

1.3 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Engineer and then only after arranging to provide temporary utility services according to requirements indicated.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

- B. Satisfactory Soils: The existing site soils are susceptible to frost heaving. Entrances and sidewalks should be designed to reduce the effects of frost action. Entrance slabs have been founded on spread footing and frost walls. Excavation beneath entrances and sidewalks abutting the building continue to at least 4.5 feet below finished grade. The entire length and width of entrance slabs and adjacent sidewalk areas should be underlain with non-frost susceptible Structural Fill to the 4.5 foot frost depth extending outward at least 4.5 feet and then transitioning up at 3H:1V to the bottom of the adjacent sidewalk or pavement subbase materials. This transition will reduce the potential for abrupt differential movement due to frost action.

The native sands are frost susceptible and not well-suited for reuse during cold weather; however, they must be reused for compacted granular borrow to raise building and paved areas.

- C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT or a combination of these groups and satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: MDOT 703.06 Type D.
- E. Base Course: MDOT 703.06 Type A or B.
- F. Compacted Structural Fill: Compacted structural fill (CSF) placed within the ZOI of footings, beneath building slabs, and other areas designated by the Contract Drawings should consist of mineral, bank-run sand, and gravel, free of organic material, snow, ice, or other unsuitable materials and should be well-graded within the following limits:

COMPACTED STRUCTURAL FILL (CSF)	
Sieve Size	Percent Finer
4-inch ¹	100
3-inch	90 to 100
1/4-inch	25 to 90
No. 40	0 to 30
No. 200	0 to 5

CSF should be placed in lifts not exceeded 12 inches in loose measure and compacted using self propelled vibratory equipment. In confined areas, maximum particle size should be reduced to 3 inch maximum loose layer reduced to 9 inches and compaction performed by hand guided equipment. A minimum of four systematic passes of the compaction equipment should be used to compact each lift. Cobbles or boulders having a size exceed 2/3 of the loose lift thickness should be removed prior to compaction.

CSF placed on the exterior of the perimeter below grade foundation walls should extend laterally a minimum of 4 ft. beyond the outside edge of the walls. Backfill beyond this limit may consist of common fill (discussed below). The top 12 in. of fill around the exterior of the building should consist of low permeability material used to minimize water infiltration adjacent to the structure. Grading is intended to promote drainage of surface water away from the structure.

The ABC Material (Paragraph M) is acceptable for CSF.

¹ Cobbles or boulders having a size exceed 2/3 of the loose lift thickness should be removed prior to compaction.

- G. **Crushed Stone:** Crushed stone fill is required for use as part of the underdrainage and infiltration, and stormwater systems. Crushed stone fill should be free of organic material, trash, snow, and ice and should conform to the following gradation requirements:

Sieve Size	Percent Finer
1-inch	100
3/4-inch	90 to 100
3/8-inch	0 to 75
No. 4	0 to 25
No. 8	0 to 5

Crushed stone for infiltration beds shall be double washed and free of visible fines. Crushed stone should be placed in lift thicknesses not exceed 12 inches in loose measure and compacted using either a vibratory plate compactor or by wheel rolling with construction equipment. Four systematic passes should be used to compact each lift except in infiltration beds where only one pass is allowed.

- H. **Common Fill:** Common fill should consist of mineral sandy soil, free from organic matter, plastic, metal, wood, ice, snow or other deleterious material and should have the characteristic that it can be readily placed and compacted. Common fill imported to the site should have a maximum of 80 percent passing the No. 40 sieve and a maximum of 40 percent finer than the No. 200 sieve. The largest particle size for common fill should not exceed 2/3 of the loose lift thickness. Silty common fill soils may require moisture control during placement and compaction. Common fill should be placed in maximum 12 inches thick loose lifts using compaction equipment as described above for CSF (refer to Item O below).
- I. **Retaining Wall Backfill:** Imported retaining wall backfill or demolished building material should consist of sand and angular gravel, free of organic material, snow, ice, or other unsuitable materials and should be well-graded within the following limits:

Sieve Size	Percent Finer
3-inch	100
1/4-inch	25 to 70
No. 40	0 to 30
No. 200	0 to 5

- J. **Rock Fill:** To be used as compacted fill more than 2 feet below parking areas or landscaped areas shall be well-graded bedrock fragments with a maximum particle size of 18 inches. Well-graded means more than thirty percent (30%) by weight is less than twelve inches (12”) in size, and more than ten percent (10%) by weight is less than two inches (2”) in size. The Contractor shall secure any rock proposed for use on the site as needed in order to meet these gradation requirements.
- K. **Choke Stone:** To be used as the first layer of fill over the surface of compacted Rock Fill to limit the migration of soil particles down into the Rock Fill. Choke Stone shall consist of either bank run sand and gravel or material that has been processed through a crusher to produce a mixture of sand and gravel that meets the gradation below.

CHOKER STONE	
Sieve Size	Percent Passing By Weight
3-inch	100
2-inch	85 to 100
1-inch	50 to 85
No. 4	25 to 50
No. 200	0 to 8

- L. Underdrain Sand: Clean, free-draining underdrain sand used for underdrains should meet the requirements for MDOT Standard Specification 703.22 Type B “Underdrain Aggregate” as given below:

MDOT 703.22 Type B Underdrain Sand	
Sieve Size	Percent Passing By Weight
1-inch	95 to 100
1/2-inch	75 to 100
No. 4	50 to 100
No. 20	15 to 80
No. 50	0 to 15
No. 200	0 to 5
NOTE: Permeability of 1×10^3 cm/sec or faster.	

- M. Demolished building material (ABC Material): Brick and concrete demolition material (ABC Material) shall be used at the site only as subbase gravel, compacted structural fill in the building footprint and within the footing ZOI, or common fill outside of athletic field turfs. The ABC Material should not be used as base gravel material or below the athletic fields.

The ABC Material must be:

1. From the site stockpile where the rubble was previously crushed as part of an earlier demolition contract (i.e., rubble cannot be brought in from other locations and crushed).
2. Free of wood, organic matter, soil, debris or other material that could adversely impact its placement or performance as compacted fill. If the materials contain rebar (metal reinforcing), all rebar must be removed and should be recycled or disposed of in an approved solid waste management facility. The material should be spread in 3” loose lifts and inspected for wood and deleterious materials. Deleterious material (wood or metal) shall be removed prior to compaction.
3. Placed in relatively uniform thickness lifts, and spread in a manner that limits segregation of the larger and smaller sized particles, and results in a uniform fill mass.
4. Confirmed to be compatible with plantings, utilities, overlying fill and other features in the fill area.
5. Sampled prior to use and as judged necessary by the Engineer during production to confirm that the gradation requirements are being achieved.

- N. Granular Borrow: Fills used to raise building and paved areas should consist of sand and gravel meeting the requirements of MDOT Standard Specification 703.19 Granular Borrow.

- O. Common Borrow: Fill used in landscape areas may consist of compactable earth meeting the requirements of MDOT Standard Specification 703.18 Common Borrow or ABC Material.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Preparation of subgrade for earthwork operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface is specified in Division 31 Section "Site Clearing." The preparation also requires the installation of the erosion controls as specified in Section 312513 and shown on the contract drawings.
- C. Protect and maintain erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing." during earthwork operations.
- D. Removal of buried loam and unsuitable soils in building pad area. There is buried loam and unsuitable soils beneath portions of the building pad that must be excavated and removed. The loam and unsuitable materials shall not be used within the building footprint nor beneath paved areas. Refer to the Geotechnical Report and Sheet GT-1 for additional information and anticipated depths of excavation for removal of buried loam and unsuitable soils.
- E. Building Pad Preparation. Relic foundations, pavements, existing fills, relic topsoil and unsuitable materials shall be completely removed beneath the proposed building footprint. Excavations from removal of relic foundations and contaminated soil removal as specified in Section 312001 should be backfilled with compacted granular fill up to the level of existing fill and relic topsoil removal. The entire building pad shall be densified with a 10-ton vibratory steel drum roller compactor after removal of the existing fill and relic topsoil.
- F. Footing Subgrade Preparation. Excavation to footing subgrade shall be completed with a smooth-edged bucket. Footing subgrades shall be densified with a ½-ton vibratory sled compactor prior to installing formwork.
- G. Paved Areas. Following removal of pavement, topsoil, organics, as well as removal and backfill of relic foundations and areas of contaminated soil removal, the native sands shall be densified with a vibratory roller compactor prior to placing compacted fills and pavement gravels. The densification process may require the addition of moisture and considerable compactive effort to achieve a relative compaction density of at least 95 percent as determined by ASTM D-1557. Fill used to raise paved areas should consist of compacted granular borrow from re-use of native on-site sands, the ABC materials or imported sources.
- H. Utility Trench Subgrades. Utility trench subgrades above the groundwater table shall be densified with a ½-ton vibratory plate compacted prior to installing utility bedding materials.

Utility trench subgrades below the groundwater table may require installation of a 6 to 12-inch thick layer of crushed stone overlying a woven geotextile fabric in order to create a working mat and drainage layer from which to dewater. This work shall be incidental to the scope of the contract.

- I. Dewatering and Shoring. Based on the subsurface findings, the contractor should anticipate the need to dewater, particularly in deeper utility excavations. Sumping and pumping dewatering techniques should be adequate to control groundwater in shallower foundation excavations; however, excavations deeper than about 8 feet below existing grades will be difficult to complete without extensive dewatering and shoring. Controlling the water levels to at least one foot below subgrade elevations will be required to help stabilize the subgrade and provide a more suitable working surface during construction.

Excavations must be properly shored and/or sloped to prevent sloughing and caving of the sidewalls during construction. Temporary, unsupported excavations above the groundwater table should be sloped back to 1V:1H or flatter. Temporary excavations below the groundwater table will require contractor designed shoring and dewatering. All excavations must be consistent with OSHA trenching regulations.

3.2 EXCAVATION – General: Refer to Section 3.3 to 3.5.

A. Excavation for Structures:

1. Excavate to indicate elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
2. Proof roll exposed granular soils with a minimum of two passes of a self-propelled vibratory roller or heavy hand-guided vibratory plate compactor until firm.
3. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Trim bottoms to required lines and grades to leave solid base to receive other work. Prevent water from accumulating on soil surfaces to reduce the possibility of soil disturbance. Re-compact any areas that are inadvertently disturbed.

3.3 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.4 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
- B. Excavate trenches to uniform widths to provide the following trench width. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit, unless otherwise indicated.
 1. A minimum and pay width of 2'-6" for conduits up to 6" diameter.

2. A minimum of 3'-0" or 4/3 the pipe inside diameter plus 1'-6" for conduits over 18".

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material, 4 inches (100 mm) deeper elsewhere, to allow for bedding course.

3.5 SUBGRADE INSPECTION

A. Proof-roll subgrade consisting of granular soils (in-situ fill or glacial till) below the building slabs, pavements, and under pavement with a minimum of four passes of a self-propelled vibratory roller or heavy hand-guided vibratory compactor, until firm. Any soft pockets and areas of excess yielding revealed by proof rolling will be removed and replaced with CSF or Subbase Material. Do not proof-roll wet or saturated subgrades or subgrades consisting of silt/clay soils (marine deposits).

B. The exposed subgrade will be examined in the field by the Engineer to observe the strength and bearing capacity of the soils. Disturbed or soft soils, as judged by the Engineer, shall be excavated and replaced with CSF without additional compensation.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Engineer, without additional compensation.

3.6 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Engineer.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Engineer.

3.7 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.8 UTILITY TRENCH BACKFILL

- A. Place backfill on subgrades free of mud, frost, snow, or ice.
- B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- C. Backfill trenches within ZOI of footings with CSF or lean concrete fill; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section “Cast-in-Place Concrete”.
- D. Provide 4-inch- (100-mm-) thick, concrete-base slab support for piping or conduit less than 30 inches (750 mm) below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches (100 mm) of concrete before backfilling or placing roadway subbase.
- E. Place and compact initial backfill of select backfill free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the utility pipe or conduit.
 - 1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
- F. Place and compact final backfill of satisfactory soil to final subgrade elevation.
- G. Install warning tape directly above utilities which are non-metallic, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

3.9 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
 - 1. Under grass and planted areas, use satisfactory soil material.
 - 2. Under walks and pavements, use satisfactory soil material.
 - 3. Under steps and ramps, use CSF.
 - 4. Under building slabs and foundations, use CSF or ABC or granular borrow below this level.
 - 5. For foundation backfill, use CSF or ABC.
 - 6. Retaining walls use Retaining Wall Backfill.

3.10 ROCK FILL

- A. Rock fill may be used in approved subgrade fill areas. Fill shall be placed, compacted similar to soil fill.

- B. Upon completion of rock fill a choke stone material shall be used above the rock fill. The material shall be placed in 6” lifts and compacted with vibratory equipment. Lifts shall be placed until there is no apparent voids after the choke stone has been compacted.

3.11 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
 - 1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
 - 2. Remove and replace, or scarify and air dry otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.12 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than 12 inches (300 mm) near structures and in loose depth for material compacted by heavy compaction equipment, and not more than 8 inches (200 mm) in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
 - 1. Under structures, building slabs, steps, and pavements, compact each layer of backfill or fill soil material at 95 percent.
 - 2. Under walkways, compact each layer of backfill or fill soil material at 92 percent.
 - 3. Under lawn or unpaved areas, compact each layer of backfill or fill soil material at 90 percent.
 - 4. For utility trenches, compact each layer of initial and final backfill soil material at 92 percent.

3.13 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
 - 1. Lawn or Unpaved Areas: Plus or minus 1 inch (25 mm).
 - 2. Walks: Plus or minus ¼” with no “bird baths”.
 - 3. Pavements: Plus or minus ¼” with no “bird baths”.

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- C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

3.14 SUBBASE AND BASE COURSES

- A. Place subbase and base course on stable, firm subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase and base course under pavements and walks as follows:
 - 1. Shape subbase and base course to required crown elevations and cross-slope grades.
 - 2. Compact subbase and base course in maximum 8 inch (200 mm) lifts in uncompacted thickness at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.15 DRAINAGE COURSE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade or filter fabric, as appropriate, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
 - 1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
 - 2. Compact each layer of drainage course to required cross sections and thicknesses to not less than 98 percent of maximum dry unit weight according to ASTM D 698.

3.16 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality control testing and to inspect the ABC material for removal of deleterious debris.
- B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work complies with requirements.
- C. Footing Subgrade: At footing subgrades consisting of CSF or ABC, tests will be performed to verify that the compaction requirements are achieved.
- D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable.
- E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions without additional compensation.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
 - 1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.
- D. Certain areas of the site are to be used for infiltration of stormwater. It is vitally important that these areas not be contaminated with sediment or fines and that drainage be diverted away from these systems until the tributary area has established vegetation and cover materials.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 312000

SECTION 312319 – DEWATERING

PART 1 – GENERAL

1.1. SUMMARY

- A. This Section includes temporary construction dewatering.

1.2. DESCRIPTION OF WORK

- A. The work includes but is not limited to providing all labor, materials, equipment and incidentals to:
 - 1. Design, furnish, install, test, operate, monitor, maintain and remove a temporary dewatering system to: (1) lower groundwater levels in soils below the final excavation level, maintain excavation stability, and prevent disturbance to soils below the final excavation level; and (2) collect and remove precipitation, surface water runoff, and construction generated waste waters from excavations in accordance with the requirements specified herein.
 - 2. As required by applicable permits, sample effluent from the temporary dewatering system, conduct laboratory testing, and report the test data to the Engineer and the authority(s) having jurisdiction over the work.
 - 3. Design, furnish, install, maintain, and operate a sediment system to treat groundwater if necessary to comply with permit(s) and discharge criteria, including treatment (if needed) to reduce contaminant concentrations in the dewatering effluent prior to discharge.

1.3. DEFINITIONS AND REFERENCE STANDARDS

- A. Engineer: Authorized representatives of the Owner. For the work covered under this Section, this term shall include S. W. Cole and DeLuca-Hoffman Associates, Inc.
- B. Contractor: Entity responsible for completing the work of this Section.
- C. Retaining Wall Construction Area: The area within 20' ahead or behind the retaining walls at the edge of the site.

1.4. JOB CONDITIONS

- A. Subsurface Information: A geotechnical report summarizing subsurface conditions has been prepared for the project by S. W. Cole and is available upon request. Please note that the engineering recommendations included in this report are to be considered “for informational purposes only”. The information provided in the contract documents supercedes the recommendations included in this report. The CONTRACTOR shall base their bid on the information provided in the contract documents.

- B. Drainage of the silty sands and silts is likely to be slow; therefore the Contractor should anticipate that pumping for days or weeks may be required prior to excavating in the retaining wall construction area to lower groundwater levels as specified herein.

1.5. DESIGN AND PERFORMANCE CRITERIA

- A. The Contractor shall be solely responsible for the design, installation, operation, performance, maintenance, and decommissioning of the temporary dewatering system.
- B. The Contractor shall design temporary dewatering systems and shall employ measures to protect existing and new site improvements and off-site structures against dewatering-induced impacts.
- C. The Contractor shall coordinate with the general contractor for access to the site to begin installation of wells and all other components of the dewatering system.
- D. The Contractor shall discharge wastewater from the temporary dewatering system into the existing storm drain system.
- E. The Contractor shall review the results of the pumping test performed by the Engineer. The results of the pumping test shall be evaluated by the Contractor and the final design of the dewatering system shall take into account the results of the pumping test. Additional sumps or drainage trenches may be necessary at locations within the excavation limits to meet the performance criteria specified herein.
- F. Install a minimum of three observation wells to monitor groundwater levels during the project at locations designated in the reviewed submittals.
- G. The final design of the dewatering components is the sole responsibility of the Contractor and may include sumps, drainage ditches, well points, wells or some combination of those components to meet the performance criteria outlined herein.
- H. Open pumping using sumps or ditches will be prohibited if such activity results in “boil” conditions, pumping of sand or fines, softening or loss of ground, or unstable excavation subgrades and slopes.
- I. Means and methods for installing dewatering wells shall be selected by the Contractor. However, use of hollow-stem augers shall not be permitted due to the potential for borehole smearing. If mud rotary drilling methods are used, use of bentonite drilling mud will not be permitted.
- J. If dewatering wells are used, the wells shall be constructed such that the annular space between the well screen and the borehole wall is between 3 and 8 in.

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- K. Dewatering wells, if used, shall be installed with appropriate sand or gravel pack filters and well screens to prevent pumping of sand or fines, and shall be developed in accordance with the reviewed design submittal. At a minimum, the wells shall be developed by pumping and surging, alternately jetting (with water or air) and pumping, or alternative method acceptable to the Engineer, until the water clears visibly and there is no visible evidence of suspended solids, including entrained soils and drilling fluids. Sand content in the water at the conclusion of well development and throughout well operation shall be less than 5 ppm, determined using a Rossum Sand Content Tester or Imhoff cone, averaged based on at least three measurements.
- L. Following well development, install pumps, motors and appurtenances, and discharge piping to a header pipe at current grades and begin pumping. A sufficient number of wells, well points, sumps, drainage ditches or some combination of these components shall be installed and operated to dewater the site and achieve the project objectives, depending on the stage of the excavation work.
- M. Groundwater levels shall be lowered at least 2 ft below excavation. The Contractor shall achieve and maintain this criterion until the drains for all of the retaining walls have been installed and connected to the existing storm drain system.
- N. Demonstrate satisfaction of the criteria herein by installing and monitoring a minimum of three observation wells. The Contractor shall also monitor existing observation wells as shown in the Haley & Aldrich report, dated 2008. Monitor, record, and submit groundwater levels obtained in observation wells and obtain the Engineer's approval prior to excavating in the retaining wall construction area. The Contractor may elect to install additional observation wells at their own cost to demonstrate the performance of its dewatering system.
- O. Dewatering components and observation wells shall be installed and operational, and the Contractor shall demonstrate that it has achieved the performance criteria herein prior to excavating deeper than El. 140 in the retaining wall construction area.
- P. As the excavation progresses, excavate new sumps and drainage ditches as needed at progressively lower elevations, and cut well risers, well screens, discharge columns and associated appurtenances, and arrange for water from the dewatering components to be pumped to the discharge point(s) via a header pipe at surface grade. Wells and well points must be protected from damage by construction equipment.
- Q. During intermediate excavation stages below the groundwater table, it is expected that the Contractor will encounter perched groundwater not completely removed by the dewatering system. The Contractor shall implement supplemental dewatering schemes including, but not limited to, a system of perimeter drainage trenches with positive drainage to the storm drain system.
- R. Modify the dewatering system at no additional cost to the Owner to achieve the requirements of this Section. Modifications may include additional sump pits, drainage trenches, dewatering wells, pumps, observation wells and other elements incidental to dewatering activities.
- S. Comply with federal, state, and local codes, ordinances, permits and regulations for disposal of discharge effluent and collected sediment.

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- T. Locate dewatering system components where they will not prohibit execution of construction activities and permanent structures.
- U. Maintain continuous and complete effectiveness of dewatering systems around-the-clock during construction. Provide backup power generation for dewatering system components and devise emergency procedures for maintaining continuous, uninterrupted dewatering operations as necessary.
- V. Design and operate the dewatering systems to prevent loss-of-ground by the pumping (removal) of fines from in-situ soils.
- W. Maintain the dewatering system components to address water quality conditions such as hardness, corrosivity and potential for encrustation and bio-fouling by bacterial growth. Maintenance shall include treatment and cleaning of well screens and redevelopment, as necessary, to maintain pumping rates and well efficiency.
- X. Maintain total suspended solids (i.e., turbidity), pH, and other contaminants within permit requirements through the use of sedimentation tanks, bag filters (or combination thereof) and pH control systems.
- Y. If requested by the Engineer, the Contractor shall excavate all unsuitable soils that become disturbed due to inadequate dewatering and replace the unsuitable soils with compacted fill, to the satisfaction of the Engineer and at no additional cost to the Owner.
- Z. Take measures to prevent damage to existing and new improvements (both on- and off-site) during the course of the Work. Repair damage, disruption, or interference to such improvements directly or indirectly caused by the Contractor's dewatering and recharge activities at no additional cost to the Owner.

1.6. SUBMITTALS

A. General

1. The Contractor shall forward submittals to the Engineer a minimum of three weeks prior to any planned work related to the Contractor's submittals.
2. The time period(s) for submittals are the minimum required by the Engineer to review, comment, and respond to the Contractor. The Engineer may require resubmission(s) for various reasons. The Contractor is responsible for scheduling specified submittals and resubmittals so as to prevent delays in the work.
3. The Contractor's submittals shall be reviewed and accepted by the Engineer prior to conducting any work.
4. The Contractor's submittals shall be prepared and stamped by a Professional Engineer registered in the State of Maine, retained by the Contractor. The Contractor's Professional Engineer shall have a minimum of five years' experience in the design of temporary construction dewatering and recharge systems similar to those required for this project.
5. The Contractor shall submit the qualifications and experience of the Engineer and the subcontractor or specialty dewatering firm responsible for the design, installation and operation of the dewatering systems.

6. Acceptance of the Contractor's submittals by the Engineer does not relieve the Contractor of the responsibility for the adequacy, safety and performance of the Work.
- B. Prior to installing dewatering components at the site, the Contractor shall submit a Plan providing details on the means and methods of drilling the proposed wells, details on the well screen, filter pack and materials proposed for installing the deep wells, piezometers and observation wells. In addition, details on the means, methods and schedule for the well installation and development shall be included in this submittal.
- C. Shop Drawings and Engineering Calculations:
1. Drawings and supporting engineering calculations for proposed dewatering systems as outlined below.
 - a. Arrangements, sizes, characteristics, capacities, locations and depths and associated instrumentation of all elements of the proposed system.
 - b. Technical data sheets for well sand/gravel materials proposed for use as filter packs around dewatering wells.
 - c. Descriptions of equipment, materials and procedures for installing, operating, maintaining and removing dewatering systems relative to the proposed sequence of excavation, foundation construction and backfilling.
 - d. Provisions for standby equipment and standby power supply.
 - e. Location of discharge points into the existing storm drain system at the site.
 - f. Manufacturer's technical literature for the flow meter and totalizer proposed to measure flow rate and total volume discharged in accordance with applicable permit requirements.
 - g. Details regarding schedule and procedure for cleaning sedimentation tanks and bag filters.
 - h. Anticipated peak and average discharge rates.
 2. Schematic details, descriptions, design calculations, and supporting technical information for proposed pretreatment systems to treat the groundwater for discharge as required by the applicable Permits.
 3. Flow monitoring data (rate and total volume) for dewatering systems on a weekly basis.
 4. Results of effluent sampling/testing per the requirements of applicable permits (e.g., TSS, oil, and grease, pH for NPDES permit requirements).
 5. Groundwater level data measured in the observation wells prior to and during excavation. This information should be submitted to the Engineer and Owner at least once per week.

PART 2 – PRODUCTS

2.1 GENERAL

- A. Materials and equipment shall be of suitable size, capacity and type to:

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1. Dewater soils below the final excavation level in accordance with the requirements established herein so that the work can be conducted in-the-dry.
 2. Collect and remove groundwater, groundwater seepage, precipitation, surface water runoff, and other construction generated waters from the excavation for the purpose of maintaining dry and stable working surfaces.
 3. Maintain suspended solids and other contaminants below permit criteria.
 4. Pump, store, manage, treat and discharge treated groundwater as necessary.
- B. Materials and equipment shall be of appropriate type and maintained in good working order at all times during the course of the Work. Any leaks or spills shall be immediately fixed or cleaned.
- C. Employ standard drilling equipment (mounted on a truck, tracks or skid) capable of installing dewatering and observation wells under site conditions at the planned time of installation. Under no circumstances shall use of any drilling fluids other than potable water or degradable polymer slurry be permitted. Hollow stem auger drilling methods shall not be permitted. Drilling procedures shall not result in borehole smearing.
- D. Provide PVC Vee-Wire well screen (0.050 in. openings and 6 in. minimum inside diameter) by Johnson Screens, Inc. of St. Paul, MN, or Engineer-approved equal. Also provide Schedule 80 PVC riser and sump.
- E. For observation wells, provide Schedule 40 slotted PVC observation well screens and risers (0.010 in. openings, 2-inch minimum inside diameter).
- F. Filter sand for the dewatering wells shall be #2 Morie sand or Engineer-approved equivalent.
- G. Filter sand for the observation wells shall be Ottawa sand or Engineer-approved equivalent.
- H. Granular bentonite shall be Enviroplug Medium, as manufactured by Wyo-Ben, Inc., Billings, MT, or Holeplug, as manufactured by Baroid Division, Petroleum Services, Inc., Houston, TX, or acceptable equivalent.
- I. Provide adequate back-up equipment in the case of equipment breakdown.
- J. Provide a calibrated flow meter and a totalizer to measure the discharge flow rate and the total volume of water discharged into the storm drain.
- K. Provide spigots in the discharge line after sediment control tanks/ bag filters and pretreatment systems for sampling water in accordance with applicable permits.

2.2 TREATMENT SYSTEMS

- A. The Contractor is responsible for compliance with Special Condition 7 of the MeDEP Site Location of Development Permit. This condition states:

“e. Construction dewatering activities shall be completed in accordance with Section F-3, "Construction Dewatering," of the Maine Erosion and Sediment Control BMP Manual, dated March 2003 to ensure that no discharge of suspended sediments occurs off-site or into protected natural resources.”

PART 3 – EXECUTION

3.1 GENERAL

- A. Install dewatering systems in accordance with the requirements herein and approved shop drawings.
- B. Furnish, install, operate, maintain, and decommission dewatering systems in accordance with the requirements herein and approved shop drawings.
- C. Monitor the quality and quantity of water discharged from the dewatering system in accordance with the requirements herein and reviewed design submittals.
- D. Observation well screens shall be continuous and shall be installed between El. 140 and the top of bedrock surface.
- E. Decommission dewatering wells (if used) and observation wells with tremied cement grout upon completion of dewatering activities. Remove the portions of the dewatering wells to within a minimum of 5 ft of ground surface.
- F. Remove and backfill other dewatering elements (such as well points, ditches and sumps) when no longer required using methods acceptable to the Engineer. Backfill any voids resulting from dewatering system removal with cement grout, concrete, or other material as directed by the Engineer to prevent potential loss of ground.

3.2 OFF-SITE DISCHARGE OF EFFLUENT

- A. Discharge groundwater to the designated locations in accordance with the reviewed submittals. Notify the Engineer a minimum of seven days prior to any discharge whether to designated on-site or off-site locations. Discharge to the storm drain shall be conducted only after receiving approval from the Engineer.
- B. Manage and treat the groundwater to meet the requirements of the permit(s). The Contractor shall comply with the most stringent criteria and requirements set forth by regulatory agencies.
- C. The Contractor shall provide notification of the unexpected or non-complying discharge to the permit authority(s), Engineer and Owner. The Contractor shall then adapt and modify the dewatering systems as required to meet the requirements of all permits. Dewatering shall not be stopped without prior approval of the Engineer once excavation extends deeper than El. 140 in the retaining wall construction area. The Contractor shall immediately cease discharging treated groundwater to the storm drains, route the water to on-site storage units and notify the Engineer if one of the conditions outlined below occurs.

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1. Discharge of oil or hazardous materials sufficient to cause a sheen is observed.
 2. Monitoring data indicate the discharge is not in compliance with permit requirements.
- D. The Contractor shall pay for all fines, penalties, and other costs associated with non-compliance of the permit(s) at no additional cost to the Owner. The Contractor shall also pay all storm drain and sewer use fees in connection with off-site discharge.
- E. Provide baffled sedimentation tanks (100 gpm capacity), bag filters, and pH control systems (as necessary) in accordance with the requirements herein and approved shop drawings. Provide sampling ports in the system at points prior to and after treatment and pretreatment (as appropriate) that are accessible at all times to obtain samples of the effluent.
- F. The Contractor shall arrange for sampling and testing of dewatering effluent, shall report the test data in the required format to the permit authority(s), Engineer and Owner, and shall perform other compliance activities in accordance with all applicable permit requirements.
- G. Clean and remove all sediment or other materials discharged from the system that accumulate in the storm drains, sewers or other existing and new improvements both on- and off-site to the satisfaction of the Engineer and the Owner of the improvement(s) at no additional cost to the Owner.
- H. The Contractor shall remove from the site and legally dispose of all by-products and spent materials resulting from pretreatment system mobilization and operation.

END OF SECTION 312319

SECTION 312513 – EROSION CONTROLS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Temporary and permanent erosion control systems.
- B. Slope Protection Systems.

1.2 RELATED SECTIONS

- A. Section 01 70 00.01 – Site Permit Requirements
- B. Section 31 10 00 – Site Clearing
- C. Section 31 20 00 – Earth Moving
- D. Erosion Control Plan for the project
- E. Construction Requirements

1.3 ENVIRONMENTAL REQUIREMENTS

- A. The Contractor shall protect adjacent properties and water resources from erosion and sediment damage throughout the life of the construction contract in accordance with the Erosion and Sediment Control Report prepared for this project and in accordance with the requirements of the plans and specifications of the City of Portland requirements. The Erosion and Sediment Control Report and Site Permits have specific restrictions on seasonal work limits, the amount of area which can be exposed at a given time, the general sequence of construction, and contractor monitoring. These affect the scheduling of the work.

Protected resources as referred to in this document include wetlands, streams or water bodies, and trees or vegetation outside of the work limit.

Prior to grubbing, orange safety fence shall be installed between the limit of grading and any protected resource. When the protected resource is a tree, the safety fence shall be installed at the drip line of the tree. If disturbance of the root system occurs, the Contractor shall have an Arborist or Nurseryman inspect the root system and provide recommendations to preserve the tree. This information shall be included in the logs for the Erosion Control Plan maintained by the Contractor.

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- B. The General Contractor will be required to designate, by name, a Registered Professional Engineer or equivalent person responsible for implementation of all erosion control. Specific responsibilities will include:
1. Assuring and certifying the contractor's construction sequence is in conformance with the specified schedule. In addition, a weekly certification stating compliance, any deviations, and corrective measures shall be filed with the owner by this person. A copy of the certification form is contained the Erosion and Sedimentation Control Report which is appended to this Specification Section.
 2. Inspection of the project work site on a weekly basis, with the installation of added erosion control measures in areas which appear vulnerable to erosion. The erosion and sediment measures shown on the contract documents are minimum provisions. Any additional measures required to comply with the permit or intent of the Erosion and Sedimentation Control plan shall be incidental to the contract.
 3. Inspection of all erosion control measures and drainage inlets after any significant rainfall. Accumulated silt/sediment should be removed when the depth of sediment reaches 50 percent of the barrier height. Accumulated silt/sediment should be removed from behind silt fencing when the depth of the sediment reaches 6 inches. A significant rainfall shall be defined as over ½ inch of precipitation in any consecutive 24-hour period.
 4. Inspect areas for catch of grass. A minimum catch of 75 percent is required prior to removal of erosion control measures.
 5. Maintaining precipitation records and monitoring forecast activity.
- C. The Owner/Engineer, Engineer will provide either an FTP site or email address for the erosion control monitoring reports to be provided to the Owner.
- D. It shall be the responsibility of the Contractor to implement, maintain, monitor and document compliance with the erosion and sediment control plan for the project and to avoid turbid discharges from the site, to avoid fugitive dust emissions, to avoid sediment from leaving the site, or affecting areas outside of the project work limits.

The work includes the submission of logs and photographic evidence of compliance with the plan at the time each pay requisition is submitted. These records shall be certified as complying with the Erosion Control Plan and this specification. Deficiencies in the logs or photographic records identified by the Owner or Engineer shall be corrected before the pay requisition is processed.

The photographic documentation must include:

1. A minimum of 10 digital photos per week showing the appropriate erosion control measures in place.
2. Evidence of stabilization of areas that are not being actively worked.
3. Documentation of any observed releases of turbid runoff or failure of any erosion control measure.

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- E. The erosion control measures specified are required to be installed in accordance with the details provided with the construction plans and manufacturer's recommendations. The method and details of the installation of these erosion control methods are of vital importance to insure the effectiveness of the erosion control measures. While precipitation amounts cannot be predicted, the Erosion Control Plan is designed to minimize erosion by restricting the amount of the site that can be open at a given time, limiting the period that an area can be open without stabilization, and requiring weather forecasts to be monitored. It is a requirement of the contract documents that these methods be incorporated on the site.
- F. Monthly Training: The Contractor and the designated person responsible for erosion control shall conduct monthly training meetings for anyone working on the site work of the project. A log shall be maintained recording the attendance and the topics of discussion. Each meeting shall include a discussion of problems that occurred in the past month, any approved changes to the Erosion Control Plan, the anticipated upcoming four-week schedule, and a general discussion of the plan requirements.
- G. Rain Gauge: The Contractor shall provide and maintain a rain gauge on the site and record the precipitation on the site during the period between the start of construction and substantial completion. A sample log is appended to these specifications.
- H. A Stormwater Pollution Control Prevention Plan Log is attached to this specification for use by the Contractor. The Engineer, Regulatory Officials, and the Engineer shall attend the first training session. This shall be conducted prior to any clearing or other land disturbing activities on the site. The Contractor shall have samples and catalog cuts for the erosion control materials that will be employed at the site for review at this initial meeting.
- I. Prior to submitting a pay requisition, the Contractor must certify that any employee or subcontractor and their employees working on site work for the project have received training and attended a training session for this project within the past 30 days. Any employee not trained shall not be permitted to work on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Quick growing grasses for temporary seeding (see seed mixes contained in Erosion and Sedimentation Report and Section 32 92 00).
- B. Hay or straw bales.
- C. Fencing for siltation control as specified on the plans. Mirafi prefabricated silt fence or approved equal.
- D. Curlex blankets by American Excelsior Company or approved equal. Curlex single net except Curlex double net in winter months.
- E. Bale stakes shall be a minimum of 4 feet in length and 1" in width.

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- F. Temporary mulches such as loose hay, straw, netting, wood cellulose or agricultural siltage.
- G. Fence stakes shall be metal stakes a minimum of 8 feet in length.
- H. Stone check dams shall be spaced according to the Erosion Control Detail Plan.
- I. Stone Sediment Barriers or SiltSacksTM, or approved equal for inlet protection.
- J. A stabilized construction entrance to be constructed of the materials identified on the contract drawings.
- K. Riprap for slopes, culvert, storm drain inlet, and outlet aprons.
- L. Sand blankets, or non-erodible native material, to protect clay or erodible subgrades.
- M. Reinforced turf. American Green P300 or approved equal.
- N. Wood mulch.
- O. Calcium chloride and water for dust control.
- P. DIRTBAG[®] as outlined on the contract drawings and specified in Section 31.
- Q. Catch basin inserts. SiltSacksTM or approved equal.
- R. Sorbent booms. Ecotech “Hula” Bug or equal.
- S. DirtGlueTM Polymar Emulsion Mixes. DirtGlueTM emulsion formulation must be approved by Owner prior to installation.
- T. Erosion Control Net. American Excelsior Curlex “Net Free” or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Review site erosion control plan attached to this section of the specifications.
- B. Deficiencies or changes in the erosion control plan as it is applied to current conditions will be brought to the attention of the Engineer and Owner and a remedial action prepared and implemented by the Contractor.

3.2 EROSION CONTROL AND SLOPE PROTECTION IMPLEMENTATION

- A. Provide catalog cuts and information concerning the erosion control products which will be used for construction for review by the Owner.
- B. Provide information concerning the installation of the erosion sedimentation control including anchorage trench provisions anchorage devices, and spacing for review by the Owner.
- C. Place erosion control systems in accordance with the erosion control plan and in accordance with approved installation procedures.

- D. This contract limits the surface area of erodible earth material exposed any time by clearing and grubbing, excavation, borrow and embankment operations. The Owner has the authority to direct the Contractor to provide immediate permanent or temporary pollution control measures. The Contractor will be required to incorporate all permanent erosion control features into the project at the earliest practical time to minimize the need for temporary controls. Cut slopes shall be permanently seeded and mulched as the excavation proceeds to the extent considered desirable and necessary to comply with the erosion control plan.
- E. The temporary erosion control systems installed by the Contractor shall be maintained to control siltation at all times during the life of the Contract. The Contractor must respond to any maintenance or additional work to comply with this specification within a 48-hour period.
- F. DIRTBAGS® are required for the discharge of any construction dewatering or pumping, and the DIRTBAG® shall be operational before any trenching.
- G. Certain erosion control measures require staged restoration. For example, reinforced cuts must be completed in 5-foot vertical increments.
- H. Areas of water quality filters may be used as temporary sediment sumps but must be removed and the subgrade reworked before the filter is constructed.
- I. The wet pond(s) require a temporary riser during construction. This shall be constructed and maintained until the tributary area is 75% restored and the risk of erosion is low.
- J. Catch basins require an Underdrain connection below subgrade. If the crushed stone and Underdrain fabric become fouled during construction they be replaced.
- K. Fugitive dust shall be controlled through construction.
- L. Sorbent booms must be installed in the catch basin before paving. These shall be replaced prior to requesting substantial completion.
- M. DirtGlue™ may be substituted to the Engineer for approval when DirtGlue™ is to be substituted for mulch, dust control, and other erosion controls of the emulsion mix, application rate, and weather condition that exist at the time of proposed installation must be approved by the Engineer.

3.3 CONSTRUCTION OF TEMPORARY EROSION CONTROL MEASURES

- A. Earth Dike Construction:
 - 1. All dikes shall be compacted by earth-moving equipment.
 - 2. All dikes shall have positive drainage to an outlet.
 - 3. Top width may be wider and side slopes be flatter if desired to facilitate crossing by construction traffic.
 - 4. Field location should be adjusted as needed to utilize a stabilized safe outlet.

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5. Earth dikes shall have an outlet that functions with a minimum of erosion. Runoff shall be conveyed to a sediment trapping device such as a sediment trap or sediment basin where either the dike channel or the drainage area above the dike are not adequately stabilized.
6. Stabilization shall be (A) in accordance with standard specifications for seed and straw mulch if not in seeding season, (B) flow channel as per the chart on the previous page.

B. Temporary Swale Construction:

1. All temporary swales shall have uninterrupted positive grade to an outlet.
2. Diverted runoff from a disturbed area shall be conveyed to a sediment trapping device.
3. Diverted runoff from an undisturbed area shall outlet directly into an undisturbed stabilized area at non-erosive velocity.
4. All trees, brush, stumps, obstructions, and other objectionable material shall be removed and disposed of so as not to interfere with the proper functioning of the swale.
5. The swale shall be excavated or shaped to line, grade, and cross section as required to meet the criteria specified herein and be free of bank projections or other irregularities which will impede normal flow.
6. Fills shall be compacted by earth moving equipment.
7. All earth removed and not needed for construction shall be placed so that it will not interfere with the functioning of the swale.
8. Stabilization shall be as per the flow channel stabilization chart below:

Type of Treatment	Channel Grade	A (5 AC. or Less)	B (5 AC. or Less)
1	0.5-3.0%	Seed and Straw Mulch	Seed and Straw Mulch
2	3.1-5.0%	Seed and Straw Mulch	Seed Using Jute or Excelsior
3	5.1-8.0%	Seed with Jute or Excelsior, Sod	Lined with 4-8' Rip-Rap or Recycled Concrete Equivalent
4	8.1-20%	Lined with 4-8' Rip-Rap	Engineered Design

9. Periodic inspection and required maintenance must be provided after each rain event.

C. Perimeter Dike/Swale Construction

1. All perimeter dike/swale shall have uninterrupted positive grade to an outlet.
2. Diverted runoff from a disturbed area shall be conveyed to a sediment trapping device.
3. Diverted runoff from an undisturbed area shall outlet into an undisturbed stabilized area at non-erosion velocity.
4. The swale shall be excavated or shaped to line grade, and cross section as required to meet the criteria specified in the standard.

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5. Stabilization of the area disturbed by the dike and swale shall be done in accordance with the standard and specifications for temporary seeding and mulching, and shall be done within 10 days.
6. Periodic inspection and required maintenance must be provided after each rain event.
Max. Drainage Area Limit: 2 Acres.

D. Water Bar Construction

1. Install the water bar as soon as the right of way is cleared and graded.
2. Disk or strip the sod from the base for the constructed ridge before placing fill.
3. Track the ridge to compact it to the design cross section.
4. The outlet shall be located on an undisturbed area. Field spacing will be adjusted to use the most stable outlet areas. Outlet protection will be provided when natural areas are not adequate.
5. Vehicle crossing shall be stabilized with gravel. Exposed areas shall be immediately seeded and mulched.
6. Periodically inspect water bars for erosion damage and sediment. Check outlet areas and make repairs as needed to restore operation.

E. Level Spreader Construction

1. The matting should be a minimum of 4 ft. wide extending 6 inches over the lip and buried 6 inches deep in a vertical trench on the lower edge. The upper edge should butt against smoothly cut sod and be securely held in place with closely spaced heavy duty wire staples at least 12 inches in length.
2. Ensure that the lip is level to uniformly spread discharge.
3. The lip shall be constructed on undisturbed soil not fill.
4. A 20 foot transition section will be constructed from the diversion channel to the spreader to smoothly blend the different dimension and grades.
5. The runoff discharge will be outleted onto a stabilized vegetated slope not exceeding 10%.
6. Seed and mulch the disturbed area immediately after construction.

F. Pipe Slope Drain Construction

1. The inlet pipe shall have a slope of 3% or steeper.
2. The top of the earth dike over the inlet pipe and those dikes carrying water to the pipe shall be at least 1' higher at all points than the top of the inlet pipe.
3. The inlet pipe shall be corrugated metal pipe with watertight connecting bands.
4. The flexible tubing shall be the same diameter as the inlet pipe and shall be constructed of a durable material with hold-down grommets spaced at 10' on center.

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5. The flexible tubing shall be securely fastened to the corrugated metal pipe with metal strapping or watertight connecting collars.
6. The flexible tubing shall be securely anchored to the slope by staking at the grommets provided.
7. A riprap apron shall be provided at the outlet. This shall consist of 6” diameter stone placed as shown.
8. The soil around and under inlet pipe and entrance section shall be hand tamped in 4” lifts to the top of the earth dike.
9. Follow-up inspection and any needed maintenance shall be performed after each storm.

G. Straw Bale Dike Construction

1. Bales shall be placed at the toe of a slope or on the contour and in a row with ends tightly abutting the adjacent bales.
2. Each bale shall be embedded in the soil a minimum of (4) inches, and placed so the bindings are horizontal.
3. Bales shall be securely anchored in place by either two stakes or re-bars driven through the bale. The first stake in each bale shall be driven toward the previously laid bale at an angle to force the bales together. Stakes shall be driven flush with the bale.
4. Inspection shall be frequent and repair placement shall be made promptly as needed.
5. Bales shall be removed when they have served their usefulness so as not to block or impede storm flow or drainage.

H. Silt Fence Construction

1. Woven wire fence to be fastened securely to fence posts with wire ties or staples. Posts shall be steel either ‘T’ or ‘U’ type or hardwood.
2. Filter cloth to be fastened securely to woven wire fence with ties spaced every 24” at top and mid section. Fence shall be woven wire, 12 ½ gauge, 6” maximum mesh opening.
3. When two sections of filter cloth adjoin each other they shall be overlapped by six inches and folded. Filter cloth shall be either Filter X, Mirafi 100X, Stabilinka T140N, or approved equivalent.
4. Prefabricated units shall be Geofab, EnviroFence, or approved equivalent.
5. Maintenance shall be performed as needed and material removed when ‘bulges’ develop in the silt fence.

I. Check Dam Construction

1. Stone will be placed on a filter fabric foundation to the lines, grades and locations shown in the plan.

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2. Set spacing of check dams to assume that the elevations of the crest of the downstream dam is at the same elevation of the toe of the upstream dam.
3. Extend the stone a minimum of 1.5 feet beyond the ditch banks to prevent cutting around the dam.
4. Protect the channel downstream of the lowest check dam from scour and erosion with stone or liner as appropriate.
5. Ensure that channel appurtenances such as culvert entrances below check dams are not subject to damage or blockage from displaced stone.

Maximum drainage area 2 acres.

J. Rock Dam Construction

1. The area under the rock dam shall be cleared and stripped of roots and other objectionable material. The reservoir shall be cleared as needed to facilitate sediment removal.
2. Dimensions shown are minimum. Trench shall be excavated from abutment to abutment on the dam centerline. Filter fabric shall be placed from upstream edge of key trench to downstream edge of apron. Joints will lap a minimum of 1 ft. with upstream strip on top.
3. Construct the rock embankment to the dimensions shown on the drawing. Rock abutments shall be maintained 2 ft. above the crest.
4. The rock dam shall be constructed prior to clearing the basin area. Stabilize all disturbed areas, except the basin area, with temporary seeding.
5. Fencing and warning signs should be placed as appropriate.

Maximum drainage area 50 acres.

K. Excavated Drop Inlet Protection Construction

1. Clear the area of all debris that will hinder excavation.
2. Grade approach to the inlet uniformly around the basin.
3. Weep holes shall be protected by gravel.
4. Upon stabilization of contributing drainage area, seal weep holes, fill basin with stable soil to final grade, compact it properly and stabilize with permanent seeding.

Maximum drainage area 1 acre.

L. Filter Fabric Drop Inlet Protection Construction

1. Filter fabric shall have an EOS of 40-85. Burlap may be used for short term applications.
2. Cut fabric from a continuous roll to eliminate joints. If joints are needed they will be overlapped to the next stake.
3. Stake materials will be standard 2' x 4' wood or equivalent. Metal with a minimum length of 3 feet.

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4. Space stakes evenly around inlet 3 feet apart and drive a minimum 18 inches deep. Spans greater than 3 feet may be bridged with the use of wire mesh behind the filter fabric for support.
5. Fabric shall be embedded 1 foot minimum below ground and backfilled. It shall be securely fastened to the stakes and frame.
6. A 2' x 4' wood frame shall be completed around the crest of the fabric for over flow stability.

Maximum drainage area 1 acre.

M. Stone and Block Drop Inlet Protection Construction

1. Lay one block on each side of the structure on its side for dewatering. Foundation shall be 2 inches minimum below rest of inlet and blocks shall be placed against inlet for support.
2. Hardware cloth or ½" wire mesh shall be placed over block openings to support stone.
3. Use clean stone or gravel ½ - ¾ inch in diameter placed 2 inches below top of the block on a 2:1 slope or flatter.
4. For stone structures only, a 1 foot thick layer of the filter stone will be placed against the 3 inch stone as shown on the drawings.

Maximum drainage area 1 acre.

N. Curb Drop Inlet Protection Construction

1. Filter fabric shall have an EOS of 40-85.
2. Wooden frame shall be constructed of 2' x 4' construction grade lumber.
3. Wire mesh across throat shall be a continuous piece 30 inch minimum width with a length 4 feet longer than the throat. It shall be shaped and securely nailed to a 2' x 4' weir.
4. The weir shall be securely nailed to 2' x 4' spacers 9 inches long spaced no more than 6 feet apart.
5. The assembly shall be placed against the inlet and secured by 2' x 4' anchors 2 feet long extending across the top of the inlet and held in place by sandbags or alternate weights.

Maximum drainage area 1 acre.

O. Pipe Outlet Sediment Trap Construction: ST-I

1. Area under embankment shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared.
2. The fill material for the embankment shall be free of roots or other woody vegetation as well as over-sized stones, rocks, organic material, or other objectionable material. The embankment shall be compacted by traversing with equipment while it is being constructed.
3. Volume of sediment storage shall be 3600 cubic feet per acre of contributory drainage.

4. Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to ½ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
 5. The structure shall be inspected after each rain and repairs made as needed.
 6. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
 7. The structure shall be removed and area stabilized when the drainage area has been properly stabilized.
 8. All fill slopes shall be 2:1 or flatter, cut slopes 1:1 or flatter.
 9. All pipe connections shall be watertight.
 10. The top 2/3 of the riser shall be perforated with one (1) inch diameter holes or slits spaced six (6) inches vertically and horizontally and placed in the concave portion of pipe. No holes will be allowed within six (6) inches of the horizontal barrel.
 11. The riser shall be wrapped with ¼ to ½ inch hardware cloth wire then wrapped with filter cloth (having an equivalent sieve size of 40-80). The filter cloth shall extend six (6) inches above the highest hole and six (6) inches below the lowest hole. Where ends of the filter cloth come together, they shall be over-lapped, folded and stapled to prevent bypass.
 12. Straps or connecting bands shall be used to hold the filter cloth and wire fabric in place. They shall be placed at the top and bottom of the cloth.
 13. Fill material around the pipe spillway shall be hand compacted in four (4) inch layers. A minimum of two (2) feet of hand compacted backfill shall be placed over the pipe spillway before crossing it with construction equipment.
 14. The riser shall be anchored with either a concrete base or steel plate base to prevent flotation. For concrete based the depth shall be twelve (12) inches with the riser embedded nine (9) inches. A ¼ inch minimum thickness steel plate shall be attached to the riser by a continuous weld around the bottom to form a watertight connection and then place two (2) feet of stone, gravel, or tamped earth on the plate.
- P. Grass Outlet Sediment Trap Construction: ST-II
1. Volume of sediment storage shall be 3600 cubic feet per acre of contributory drainage area.
 2. Minimum crest width shall be 4 x drainage area.
 3. Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to ½ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
 4. The structure shall be inspected after each rain and repairs made as needed.
 5. Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.
 6. The sediment trap shall be removed and area stabilized when the remaining drainage drainage area has been properly stabilized.

7. All cut slopes shall be 1:1 or flatter.

Maximum drainage area 5 acres.

Q. Catch Basin Sediment Trap Construction: ST-III

1. Sediment shall be removed and the trap restored to its original dimensions when the sediment has accumulated to $\frac{1}{2}$ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
2. The volume of sediment storage shall be 3600 cubic feet per acre of contributory drainage.
3. The structure shall be inspected after each rain and repairs made as needed.
4. Construction operations shall be carried out in such a manner that erosion and water pollution shall be minimized.
5. The sediment trap shall be removed and the area stabilized when the constructed drainage area has been properly stabilized.
6. All cut slopes shall be 1:1 or flatter.

Maximum drainage area 3 acres.

R. Stone Outlet Sediment Trap Construction: ST-IV

1. Area under embankment shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared.
2. The fill material for the embankment shall be free of roots and other woody vegetation as well as over-sized stones, rocks, organic material or other objectionable material. The embankment shall be compacted by traversing with equipment while it is being constructed.
3. All cut and fill slopes shall be 2:1 or flatter.
4. The stone used in the outlet shall be small riprap 4"-8" along with a 1' thickness of 2' aggregate placed on the upgrade side on the small riprap or embedded filter cloth in the riprap.
5. Sediment shall be removed and trap restored to its original dimensions when the sediment has accumulated to $\frac{1}{2}$ the design depth of the trap.
6. The structure shall be inspected after each rain and repairs made as needed.
7. Construction operations shall be carried out in such a manner that erosion and water pollution is minimized.
8. The structure shall be removed and the area stabilized when the drainage area has been properly stabilized.
9. Maximum drainage area 5 acres.

S. Riprap Outlet Sediment Traps Construction: ST-V

1. The area under embankment shall be cleared, grubbed and stripped of any vegetation and root mat. The pool area shall be cleared.

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2. The fill material for the embankment shall be free of roots or other woody vegetation as well as over-sized stones, rocks, organic material or other objectionable material. The embankment shall be compacted by traversing with equipment while it is being constructed. Maximum height of embankment shall be five (5) feet, measured at centerline of embankment.
 3. All fill slopes shall be 2:1 or flatter, cut slopes 1:1 or flatter.
 4. Elevation of the top of any dike directing water into trap must equal or exceed the height of embankment.
 5. Storage area provided shall be figured by computing the volume available behind the outlet channel up to an elevation of one (1) foot below the level weir crest.
 6. Filter cloth shall be placed over the bottom and sides of the outlet channel prior to placement of stone. Sections of fabric must overlap at least one (1) foot with section nearest the entrance placed on top. Fabric shall be embedded at least six (6) inches into existing ground at entrance outlet channel.
 7. Stone used in the outlet channel shall be four (4) to eight (8) inch riprap to provide a filtering effect. A layer of filter cloth shall be embedded one (1) foot with section nearest entrance placed on top. Fabric shall be embedded at least six (6) inches into existing ground at entrance of outlet channel.
 8. Sediment shall be removed and trap restored to its original dimensions when sediment has accumulated to $\frac{1}{2}$ the design depth of the trap. Removed sediment shall be deposited in a suitable area and in such a manner that it will not erode.
 9. The structure shall be inspected after each rain and repaired as needed.
 10. Construction operations shall be carried out in such a manner that erosion and water pollution are minimized.
 11. The structure shall be removed and the area stabilized when drainage area has been properly stabilized.
 12. Drainage area for this practice is limited to 15 acres or less.
- T. Portable Sediment Tank Construction
1. Clean out the sediment tank when one third (1/3) filled with silt.
 2. Steel drums are used as an example due to their ready availability. Any tanks may be used, providing that the volume requirements are met.
 3. All sediment collected in the tank shall be disposed of in a sediment trapping device or as approved by the inspector.
- U. Riser Base Details Construction
1. The concrete base shall be poured in such a manner to insure that the concrete fills the bottom of the riser to the invert of the outlet pipe to prevent the riser from breaking away from the base.

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2. With aluminum or aluminized pipe, the embedded section must be painted with chromate or equivalent.
3. Riser base may be sized as computed using floatation with a factor of safety of 1.2.

V. Stabilized Construction Entrance

1. Stone Size – Use 2” stone, or reclaimed or recycled concrete equivalent.
2. Length – Not less than 50 feet (except on a single residence lot where a 30 foot minimum length would apply).
3. Thickness – Not less than six (6) inches.
4. Width – Twelve (12) foot minimum, but not less than the full width at points where ingress or egress occurs. Twenty-four (24) foot if single entrance to site.
5. Filter Cloth – Will be placed over the entire area prior to placing of stone.
6. Surface Water – All surface water flowing or diverted toward construction entrances shall be piped across the entrance. If piping is impractical, a mountable berm with 5:1 slopes will be permitted.
7. Maintenance – The entrance shall be maintained in a condition which will prevent tracking or flowing of sediment onto public rights-of-way, all sediment spilled, dropped, washed or tracted onto public rights-of-way must be removed immediately.
8. When washing is required, it shall be done on an area stabilized with stone and which drains into an approved sediment trapping device.
9. Periodic inspection and needed maintenance shall be provided after each rain.

W. Sump Pit Construction

1. Pit dimensions are optional.
2. The standpipe should be constructed by perforating a 12-24” diameter corrugated or PVC pipe.
3. A base of 2” aggregate should be placed in the pit to a depth of 12” after installing the standpipe, the pit surrounding the standpipe should be backfilled with 2” aggregate.
4. The standpipe should extend 12-18” above the lip of the pit.
5. If discharge will be pumped directly to a storm drainage system, the standpipe should be wrapped with filtercloth before installation. If desired, ¼” – ½” hardware cloth may be placed around the standpipe, prior to attaching the filtercloth.

MULCH ANCHORING REQUIREMENTS

Anchoring Method or Material	Kind of Mulch to be Anchored	How to Apply
1. Peg and Twine	Hay or straw	After mulching, divid areas into blocks approximately 1 sq. yd. in size. Drive 4-6 pegs per block to within 2” to 3” of soil surface. Secure mulch to surface by stretching twine between pegs in criss-cross pattern on each block. Secure twine around each peg with 2 or more tight turns. Drive pegs flush with soil. Driving stakes into ground tightens the twine.
2. Mulch Netting	Hall or straw	Staple the light-weight paper, jute, wood fiber, or plastic nettings to soil surface according to manufacturer’s recommendations. Should be biodegradable. Most products are not suitable for foot traffic.
3. Wood Cellulose Fiber	Hay or Straw	Apply with hydroseeder immediately after mulching. Use 500 lbs. Wood fiber per acre. Some products contain an adhesive material, possible advantageous.
4. Mulch Anchoring Tool	Hay or Straw	Apply mulch and pull a mulch anchoring tool (blunt, straight discs) over mulch as near to the contour as possible. Mulch material should be “tucked” into soil surface about 3”.
5. Chemical	Hay or Straw	Apply Terra Tack AR 120 lbs./ac. in 480 gal. of water (#156/ac.) or Aerospray 70 (60 gal/ac.) according to manufacturer’s instructions. Avoid application during rain. A 24-hour curing period and a soil temperature higher than 45° Fahrenheit are required.

END OF SECTION 312513

SECTION 312573 – DIRTBAG® SPECIFICATIONS FOR CONTROL OF SEDIMENT

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This work shall consist of furnishing, placing and removing the DIRTBAG® pumped sediment control device for erosion-sediment control. The DIRTBAG® pumped-silt control system is marketed by:

ACF Environmental, Inc.
 2831 Cardwell Drive
 Richmond, Virginia 23234
 Phone: 800-448-3636
 Fax: 804-743-7779

- B. Eight (8) DIRTBAGS® shall be included as part of the base bid.

PART 2 - MATERIALS

2.1 DIRTBAG®

- A. The DIRTBAG® shall be a non-woven bag which is sewn with a double needle matching using a high strength thread.
- B. The DIRTBAG® seams shall have an average wide width strength per ASTM D-4884 as follows.

DIRTBAG® Style	Test Method	Test Result
DIRTBAG® 53	ASTM D-4884	60 LB/IN
DIRTBAG® 55	ASTM D-4884	100 LB/IN

- C. Each standard DIRTBAG® shall be supplied with fill spout large enough to accommodate a 4” discharge hose and straps to secure the hose and prevent pumped water from escaping without being filtered.
- D. The geotextile fabric shall be non-woven fabric with the following properties:

Properties	Test Method	Units	Non-Woven	
			53	55
Weight	ASTM D-3776	Oz/yd	8	10
Grab Tensile	ASTM D-4632	Lbs.	203	250
Puncture	ASTM D-4833	Lbs.	130	165
Flow Rate	ASTM D-4491	Gal/Min/Ft ²	80	70
Permittivity	ASTM D-4491	Sec. ¹	1.5	1.3

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Mullen Burst	ASTM D-3786	Lbs. ⁱⁿ²	400	550
UV Resistant	ASTM D-4355	%	70	70
AOS % Retained	ASTM D-4751	%	100	100

All properties are minimum average roll value except the weight of the fabric which is given for information only.

PART 3 – CONSTRUCTION SEQUENCE

- 3.1 Install DIRTBAG® on a prepared crushed stone pad overlying Mirafi 600X as shown on the contract drawings. Strap the neck of the DIRTBAG® tightly to the discharge hose. The preparation of a DIRTBAG® area is required before any trenching. Any water pumped from the construction site must be discharged through a DIRTBAG®.
- 3.2 It may be necessary to use hay/poly or other measures to keep the DIRTBAG® from freezing during winter months.
- 3.3 The DIRTBAG® is full when it no longer can efficiently filter sediment or pass water at a reasonable rate. Flow rates will vary depending on the size of the DIRTBAG®, the type and amount of sediment discharged into the DIRTBAG®, the type of ground, rock or other substance under the bag and the degree of the slope on which the bag lies. Under most circumstances, the vendor claims DIRTBAGS® will accommodate flow rates of 1,500 gallons per minute. Use of excessive flow rates or overfilling DIRTBAG® with sediment will cause ruptures of the bags or failure of the hose attachment straps.
- 3.4 Dispose of DIRTBAG® in accordance with Local, State, and Federal regulations. If allowed, the DIRTBAG® may be cut open and the contents seeded after removing visible fabric. DIRTBAG® is strong enough to be lifted with added straps if it must be hauled away (extra option). Off-site disposal may be facilitated by placing the DIRTBAG® in the back of the dump truck or flatbed prior to use and allowing the water to drain from the bag in place, thereby dismissing the need to lift the DIRTBAG®.

END OF SECTION 312573

SECTION 321100 – BASE COURSES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Granular Base and Subbase (also referred to as base and subbase aggregates or base and subbase gravels).

1.2 RELATED REQUIREMENTS

- A. Section 31 10 00 - Site Clearing
- B. Section 31 20 00 – Earth Moving
- C. Section 32 12 16 - Asphaltic Paving
- D. Section 32 16 00 - Curbs and Sidewalks
- E. Geotechnical Report

1.3 REFERENCES

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12 inch (304.8 mm) Drop.
- B. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lbs (4.54 Kg) Rammer and 18 inch (457 mm) Drop.
- C. ASTM D2167 - Test for Density and Unit Weight of Soil in Place by the Rubber Balloon Method.
- D. ASTM D1556 - Test Method for Density of Soil in-place by the Sand-Cone Method.
- E. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth) Method B (Direct Transmission).
- F. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

PART 2 - PRODUCTS

2.1 FILL MATERIALS

- A. Submit materials certificate to on-site independent testing laboratory which is signed by material producer and Contractor, certifying that materials comply with, or exceed, the requirements herein. Materials shall comply with the gradations specified in Section 31 20 00, Earth Moving.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify substrate has been inspected, gradients and elevations are correct, and dry.

3.2 CONSTRUCTION

- A. Perform base and subbase course construction in a manner that will drain surface properly at all times and at same time prevent runoff from adjacent areas from draining onto base course or subbase construction.
- B. Compact base material to not less than 95% of maximum density as determined by ASTM D-1557 unless otherwise indicated on the Drawings.
- C. Granular Subbase: Construct to thickness indicated on Drawings; apply in lifts or layers not exceeding 8", measured loose.
- D. Granular Base: Construct to thickness indicated on Drawings. Apply in lifts or layers not exceeding 4" measured loose.
- E. All work of this section shall conform to the requirements of Sections 304 of the Maine Department of Transportation Specification for furnishing, placing, and surface tolerance of aggregate base and subbase courses.

3.03 FIELD QUALITY CONTROL

- A. An Independent Testing Laboratory, retained by the Owner, shall perform construction testing of in-place base courses for compliance with requirements for gradation and density. The Contractor shall retain an independent surveyor to verify paving base course tolerances (by rod and level readings on no more than fifty-foot centers) to +0.05' of design elevation that allow for paving thickness as shown in the Drawings. Contractor shall provide instruments and a suitable benchmark and perform all survey. The Contractor may, at his option, retain his own test laboratory for quality control, production schedules, or for any other reason at no cost to the Owner.

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- B. The following tests shall be performed on each type of material used as base and subbase course material:
1. Moisture and Density Relationship: ASTM D 698 or ASTM D 1557.
 2. Mechanical Analysis: AASHTO T-88
 3. Plasticity Index: ASTM D-4318-84
 4. Base and subbase material thickness: Perform one test for each 20,000 square feet in-place base material area.
 5. Base and subbase material compaction: Perform one test in each lift for each 20,000 square feet in-place base material area.
 6. Test each source of base material for compliance with applicable state highway specifications.
- C. Field density tests for in-place materials shall be performed according to one of the following standards as part of construction testing requirements:
1. Sand-Cone Method: ASTM D1556
 2. Balloon Method: ASTM D2167
 3. Nuclear Method: ASTM D2922, Method B (Direct Transmission).
- D. Independent Testing Laboratory shall prepare test reports that indicate test location, elevation data, and test results. The Engineer, Owner and Contractor shall be provided with copies of reports within 96 hours of time test was performed. In event that any test performed fails to meet these Specifications, the Owner and Contractor shall be notified immediately by Independent Testing Laboratory. The Owner reserves right to employ a separate testing laboratory and to direct any testing that is deemed by them to be necessary. Contractor shall provide free access to site for testing activities.
- E. Any base or subbase courses which become contaminated due to weather, erosion, or other activities, whether or not such contamination is under the control of the Contractor shall be removed and replaced. Said removal and replacement shall be incidental to the work and no additional payment will be made to the Contractor.

END OF SECTION 321100

SECTION 321216 – ASPHALTIC PAVING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Provide all material and labor for the placement of surface course and binder course on roads, access drives, parking lots, sidewalks, and walkways. Reference Appendix A for Superpavement requirements which, if used, replace this and MDOT Section 401 in their entirety.

1.2 REFERENCES

- A. December 2002 MDOT Standard Specifications, Highways & Bridges, including relevant updates, except as modified herein.
- B. December 2002 MDOT Standard Details, Highways & Bridges.
- C. MS-2 - Mix design methods for asphalt concrete and other hot mix types - The Asphalt Institute (AI).
- D. MS-3 - Asphalt Plant Manual - The Asphalt Institute (AI).
- E. Hot Mix Asphalt Paving Handbook - US Army Corp of Engineers, UN-13 (CE MP-ET).
- F. MS-19 - Basic Asphalt Emulsion Manual - The Asphaltic Institute (AI).
- G. ASTM D946 - Penetration - Graded Asphalt Cement for use in Pavement Construction.
- H. AASHTO M-226/ASTM D3381 Asphalt Cement.
- I. AASHTO M-140/ASTM D997 or AASHTO M-208/ASTM D-2397 Tack Coat.
- J. AASHTO M-117/ASTM D242 Mineral Filler.
- K. AASHTO T-245/ASTM D1559 Marshall Mix Design.
- L. Approved and released for construction plans (for State Highway work, there may be a difference between “Released for Bid” and “Approved and Released for Construction” drawings. Any substantive changes shall be addressed by approved change order before commencing the work).

1.3 RELATED SECTIONS

- A. Section 312000 – Earth Moving

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- B. Section 321100 – Base Courses
- C. Section 321600 - Curbs and Sidewalks
- E. Section 321723.13 – Painted Pavement Markings

1.4 SUBMITTALS

- A. Design Mix: Before any asphaltic concrete paving is constructed, the Contractor shall submit the proposed actual design mix to the Owner for review and/or approval. Design mix submittal shall follow the format as indicated in the Asphalt Institute Manual MS-2, Marshall Stability Method; and shall include the type/name of the mix, gradation analysis, asphalt cement grade used, Marshall Stability (lbs), flow, effective asphalt content (percent), and direct references to the applicable highway department specifications sections for each material. Design shall be for a mixture listed in the most recent edition of roadway specifications of the state in which the project is to be constructed. In no case shall a mix design over three years old be submitted.
- B. Material Certificates: Submit materials certificate to an independent testing laboratory retained by the Owner. The certificates shall be signed by the material producer and contractor, certifying that materials comply with, or exceed, the requirements herein.
- C. Field density test results, minimum 1 per 100 tons of bituminous pavement placed including sta/offset of test.
- D. Plant inspection reports to verify pavement batch plant and paving equipment meets or exceeds MDOT Specification 401. The inspections shall be conducted by an independent testing firm retained by the Owner.
- E. LEED Documentation Submittals: Provide the following documentation to the Owner of Record. Refer to and utilize the project LEED Letter Templates provided by the Owner of Record for the form and content required for:
 - 1. Credit MR 4: Provide LEED Letter Template and final statement of costs for all recycled content materials.
 - 2. Credit MR 5: Provide LEED Letter Template and final statement of costs for all regional materials.

1.5 JOB CONDITIONS

- A. Weather Limitations:
 - 1. Apply tack coats when ambient temperature is above 40 degrees F, and when temperature has been above 35 degrees F for 12 hours immediately prior to application.
 - 2. Construct asphaltic concrete paving when atmospheric temperature is above 40 degrees F base, 50 degrees F surface.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Provide asphaltic concrete mixture as recommended by local or state paving authorities to suit project conditions. Use locally available materials and gradations which meet State Department of Transportation specifications and exhibit satisfactory record on previous installations.
- B. Asphalt Cement: Comply with AASHTO M-226/ASTM D 3381; Table 2 AC-10, AC-20, or AC-30, AR-80, viscosity grade, depending on local mean annual air temperature. (See following chart):

Temperature Condition	Asphalt Grades
Cold, mean annual air temperature < 7° C (45° F)	AC-10 85/100 pen.
Warm, mean annual air temperature between 7° C (45° F) and 24° C (75° F)	AC-20 60/70 pen.
Hot, mean annual air temperature > 24° C (57° F)	AC-30

Final acceptance of the proper grade of A.C. shall be made by the Owner's Engineer.

- C. Tack Coat: Emulsified asphalt; AASHTO M-140/ASTM D 997 or M 208/ASTM D 2397, SS-1h, CSS-1, or CSS-1h, diluted with one part water to one part emulsified asphalt.
- D. Mineral Filler: Rock or slag dust, hydraulic cement, or other inert material complying with AASHTO M-17/ASTM D242, if recommended by applicable state highway standards.
- E. Asphalt-Aggregate Mixture: Unless otherwise noted on the Drawings, the Design Mix shall have a minimum stability based on a 50-blow Marshall complying with ASTM D 1559 of 1000 lbs. with a flow between 8 and 16. The Design Mix shall be within sieve analysis and bitumen ranges below:

SIEVE ANALYSIS OF MIX

Square Sieve	Total Percent Passing	Percent Tolerance
3/4"	100	
1/2"	80-100%	5%
3/8"	65-93%	4%
#8	40-55%	4%
#50	12-27%	2%
#200	0-10%	0%

Percent bitumen by weight of total mix: 5.0 - 8.5.
Air voids: 3-6%
Percent aggregate voids filled with asphalt cement: 70-82%
Allowable variance of percent bitumen by weight of total mix=0.4

2.2 EQUIPMENT

Maintain all batch plant and paving equipment in satisfactory operating condition and correct breakdowns in a manner that will not delay or be detrimental to progress of paving operations.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove loose material from compacted base material surface immediately before applying prime coat.
- B. Proof roll prepared base material surface to check for areas requiring additional compaction and areas requiring removal and recompaction.
- C. Do not begin paving work until deficient base material areas have been corrected and are ready to receive paving.

3.2 APPLICATIONS

- A. Tack Coat:
 - 1. Apply to contact surfaces of previously constructed asphaltic concrete base courses or Portland cement concrete and surfaces abutting or projecting into asphalt concrete and surfaces abutting or projecting into asphalt concrete pavement.
 - 2. Apply tack coat to asphaltic concrete base course or sand asphalt base course. Apply emulsified asphalt tack coat on the surface of all such bases where asphaltic concrete paving will be constructed.
 - 3. Apply emulsified asphalt tack coat in accordance with APWA Section 2204 and applicable state highway specifications.
 - 4. Apply at minimum rate of 0.05 gallon per square yard of surface.
 - 5. Allow to dry until at proper condition to receive paving.

3.3 ASPHALTIC CONCRETE PLACEMENT

- A. Place asphalt concrete mixture on completed compacted subgrade surface, spread, and strike off. Spread mixture at following minimum temperatures:
1. When ambient temperature is between 40 degrees F and 50 degrees F: 285 degrees F.
 2. When ambient temperature is between 50 degrees F and 60 degrees F: 280 degrees F.
 3. When ambient temperature is higher than 60 degrees F: 275 degrees F.
- B. Whenever possible, all pavement shall be spread by a finishing machine. Inaccessible or irregular areas, pavement may be placed by hand methods. The hot mixture shall be spread uniformly to the required depth with hot shovels and rakes. After spreading, the hot mixture shall be carefully smoothed to remove all segregated coarse aggregate and rake marks. Rakes and lutes used for hand spreading shall be of the type designed for use on asphalt mixtures. Loads shall not be dumped faster than they can be properly spread. Workers shall not stand on the loose mixture while spreading.
- C. Paving Machine Placement: Apply successive lifts of asphaltic concrete in transverse directions with the surface course placed in the direction of surface-water flow. Place in typical strips not less than 10'-0" wide.
- D. Joints: Make joints between old and new pavements, or between successive days' work, to ensure continuous bond between adjoining work. Construct joints to have same texture, density, and smoothness as other sections of asphalt concrete course. Clean contact surfaces and apply tack coat.

3.4 WEATHER AND SEASONAL LIMITATIONS

For weather limitations the State of Maine will be considered to be divided into two paving zones:

- (a) Zone 1: All area north of US Route 2 from Gilead to Brewer and north of Route 9 from Brewer to Calais.
- (b) Zone 2: All area south of Zone 1 including the US Route 2 and Route 9 boundaries.

Bituminous plant mix for use other than traveled way wearing course may be placed in either zone between the dates of April 15th and November 15th, provided that the air temperature as determined by an approved thermometer placed in the shade at the paving location is 35 degrees F or higher and the area to be paved is not frozen. Plant mix to be placed as traveled way wearing course may be placed in Zone 1 between the dates of May 1st and the Saturday following October 1st and in Zone 2 between the dates of April 15th and the Saturday following October 15th provided the air temperature determined above is 50 degrees F or higher.

Any hot bituminous base or binder course that is to be subject to traffic during the winter months shall have its gradation densified or asphalt content (percent of mix) adjusted through a change in the job mix formula as submitted by the Contractor and approved by the Owner.

3.5 ROLLING AND COMPACTION

- A. The mixture, after being spread, shall be thoroughly compacted by rolling as soon as it will bear the weight of the rollers without undue displacement. Mixture shall be compacted to a minimum, of 92% theoretical maximum density. The number, weight, and types of rollers and sequences of rolling operations shall be such that the required density and surface are consistently attained while the mixture is in a workable condition.
- B. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers.
- C. Breakdown Rolling: Accomplish breakdown or initial rolling immediately following rolling of joints and outside edge. Check surface after breakdown rolling, and repair displaced areas by loosening and filling, if required, with hot material.
- D. Second Rolling: Follow breakdown rolling as soon as possible, while mixture is hot. Continue second rolling until mixture has been thoroughly compacted.
- E. Finish Rolling: Perform finish rolling while mixture is still warm enough for removal of roller marks. Continue rolling until roller marks are eliminated and course has attained maximum density.
- F. Patching: Remove and replace paving areas mixed with foreign materials and defective areas. Cut out such areas and fill with fresh, hot asphalt concrete. Compact by rolling to maximum surface density and smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 FIELD QUALITY CONTROL

- A. An Independent Testing Laboratory, shall be retained to perform construction testing of in-place asphaltic concrete courses for compliance with requirements for thickness, density, composition and surface smoothness. Asphaltic surface and asphaltic base/binder courses shall be randomly cored at a minimum rate of one core for every 20,000 square feet of paving. In no event shall less than three cores in light duty areas and three cores in heavy duty areas shall be obtained. Coring holes shall be immediately filled with full-depth asphalt or with concrete. Asphaltic Concrete pavement samples shall be tested for conformance with the mix design. Refer to the general contract conditions for clarification on the cost for the independent laboratory.
- B. Grade Control: Establish and maintain required lines and elevations.
- C. Thickness: In-place compacted thickness shall not be less than thickness specified on the drawings. Areas of deficient paving thickness shall receive a tack coat and a minimum 1" overlay; or shall be removed and replaced to the proper thickness, at the discretion of the

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Owner's; until specified thickness of the course is met or exceeded at no additional expense to the Owner.

- D. Surface Smoothness: Testing shall be performed on the finished surface of each asphalt concrete course for smoothness, using 10'-0" straightedge applied parallel with, and at right angles to centerline of paved area. The results of these tests shall be made available to the owner upon request. Surfaces will not be acceptable if exceeding following tolerances for smoothness:

Base Course Surface:	1/4"
Wearing Course Surface:	3/16"

- E. Check surface areas at intervals necessary to eliminate ponding areas. Remove and replace unacceptable paving as directed by Owner.
- F. Compaction: Field density tests for in-place materials shall be performed by examination of field cores in accordance with one of the following standards:

1. Bulk specific gravity of paraffin-coated specimens: ASTM D-1188.
2. Bulk specific gravity using saturated surface-dry specimens: ASTM D-2726.

Rate of testing shall be one core per 20,000 square feet of pavement, with a minimum of 3 cores from heavy-duty areas and 3 cores from standard-duty areas. Cores shall be cut from areas representative of the project.

Areas of insufficient compaction shall be delineated, removed, and replaced in compliance with the specifications at no expense to the Owner.

- G. Pavement Plant Inspection: The paving plant shall be inspected a minimum of one week prior to pavement placement to verify the plant meets the requirements outlined in Section 401. Random inspection and sampling during pavement placement shall be conducted and documented by a testing firm hired and paid for by the Owner.
- H. After the binder pavement is placed, the Contractor shall retain an independent surveyor to profile the centerline of the access drive at a minimum of 25-foot stations plus survey the elevations at the locations of any pavement spot grades shown on the drawing and all catch basin inlets. This survey information shall be plotted on the drawing access drive profile and a grading plan. The Contractor shall supply this information in triplicate to the Engineer with copies to the Owner, Owner and Construction Manager. A narrative identifying any areas which do not meet the specification tolerances of subsection E of this specification with an outline of corrective measures shall accompany the submission. The Owner shall have four working days upon certified receipt of these data to issue a letter authorizing surface pavement to be placed.

END OF SECTION 321216

APPENDIX A
SECTION 401

HOT MIX ASPHALT PAVEMENT

Section 401 of MDOT Standard Specifications and the preceding Asphaltic Concrete section are deleted in their entirety and replaced by the following:

401.01 Description. The Contractor shall furnish and place one or more courses of Superpave Hot Mix Asphalt Pavement (SHMA) on an approved base in accordance with the Contract documents and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or established. The Owner will accept this Work under Quality Assurance (QA) provisions, in accordance with these specifications and the requirements of Section 106.

For the purposes of this Section, the Owner shall be defined as the developer or their assigned agent in charge of construction supervision and inspection.

MATERIALS

401.02 Composition of Mixtures. The Contractor shall compose the Hot Mix Asphalt Pavement with aggregate, Performance Graded Asphalt Binder (PGAB), and mineral filler if required. SHMA shall be designed and tested according to AASHTO TP-4. The Contractor shall size, uniformly grade, and combine the aggregate fractions in proportions that provide a mixture meeting the grading requirements of the Job Mix Formula (JMF). The Contractor may use a maximum of 20 percent reclaimed asphalt pavement in any base, binder or shim course, and in any wearing course placed on shoulders (excluding Urban areas).

The Contractor shall submit a JMF for approval. A JMF shall be submitted for testing to a laboratory selected by the Owner for each mixture to be supplied at least 15 calendar days prior to production. The JMF shall establish a single percentage of aggregate passing each required sieve size within the limits shown in Table 1, and shall not cross the restricted zone. The general composition limits given in Table 1 indicate the control points of mixtures permissible under this specification. The JMF shall state the source, gradation, and percentage to be used of each portion of the aggregate, and mineral filler if required. It shall also state the proposed PGAB content, the name and location of the refiner and the supplier for the source of PGAB submitted for approval, and the type of PGAB modification if applicable.

In addition, the Contractor shall provide the following information in the proposed JMF.

Superpave Stockpile Gradation Summary
Superpave Design Aggregate Structure Consensus Property Summary
Superpave Design Aggregate Structure Trial Blend Gradation Plots
Superpave Trial Blend Results (summary)
PGAB Specific Gravity and temperature/viscosity charts and Recommended mixing and
compaction temperatures from supplier
Material Safety Data Sheets (MSDS) for PGAB

Table 1: COMPOSITION OF MIXTURES – CONTROL POINTS

SIEVE SIZE	GRADING			
	TYPE 25 mm	TYPE 19 mm	TYPE 12.5 mm	TYPE 9.5 mm
	PERCENT BY WEIGHT PASSING – COMBINED AGGREGATE			
37.5 mm	100			
25 mm	90-100	100		
19 mm	-90	90-100	100	
12.5 mm	-	-90	90-100	100
9.5 mm	-	-	-90	90-100
4.75 mm	-	-	-	-90
2.36 mm	15-41	23-49	28-58	32-67
1.18 mm	-	-	-	-
0.60 mm	-	-	-	-
0.30 mm	-	-	-	-
0.075 mm	1-7	2-8	2-10	2-10

SIEVE SIZE	RESTRICTED ZONES			
	TYPE 25 mm	TYPE 19 mm	TYPE 12.5 mm	TYPE 9.5 mm
	PERCENT BY WEIGHT PASSING – COMBINED AGGREGATE			
37.5 mm	-	-	-	-
25 mm	-	-	-	-
19 mm	-	-	-	-
12.5 mm	-	-	-	-
9.5 mm	-	-	-	-
4.75 mm	39.5	-	-	-
2.36 mm	26.8-30.8	34.6	39.1	47.2
1.18 mm	18.1-24.1	22.3-28.3	25.6-31.6	31.6-37.6
0.60 mm	13.6-17.6	16.7-20.7	19.1-23.1	23.5-27.5
0.30 mm	11.4	13.7	15.5	18.7
0.075 mm	-	-	-	-

At the time of JMF submittal, the Contractor shall identify and make available the stockpiles of all proposed aggregates at the plant site. The Owner shall obtain samples for laboratory testing. The Contractor shall also make available to the Owner the PGAB proposed for use in the mix in sufficient quantity to test the properties of the asphalt and to produce samples for testing of the mixture. Prior to the start of paving, the Contractor and the Owner shall split a production sample for evaluation. The Contractor shall test its split of the sample and determine if the results meet the requirements of the MDOT’s written policy for mix design verification (Available at the Central Lab in Bangor). If the results are found to be acceptable, the Contractor will forward their results to the Owner’s laboratory, which will test the Owner’s split of the sample. The results of the two split samples will be compared and shared between the Owner and the Contractor. If the Owner finds the mixture acceptable, an approved JMF will be forwarded to the Contractor and paving may commence.

The Contractor shall submit a new JMF for approval each time a change in aggregate source, a significant change in proportions, or a change in PGAB is proposed. The same approval process shall be followed.

TABLE 2 – SUPERPAVE Volumetric Design Criteria

Estimated Traffic, million 80 kN ESALs	%G @N _{initial}	Voids in the Mineral Aggregate (VMA)					Voids Filled With Binder (VFB)		Fines to Effective Binder Ratio (P _{0.075} /P _{bc})	
		9.5 mm	12.5 mm	19.0 mm	25.0 mm	37.5 mm	Min.	Max	Min.	Max
		Minimum								
<0.3	<91.5	15.0%	14.0%	13.0%	12.0%	11.0%	70	80	0.6	1.2
0.3 to <1.0	<90.5						65	78		
1.0 to <3.0	<89.5						65	78		
3.0 to <10	<89						65	75*		
10 to <30							65	75*		
30 to <100							65	75*		
≥100							65	75*		

*For 9.5 mm nominal maximum aggregate size mixtures, the maximum VFB is 76.

As design criteria, Voids @ N_{des} shall be 4.0%, Voids @ N_{max} shall be ≥ 2.0%

401.03 Aggregates. Fine aggregate, that material passing the 2.36 mm sieve, shall not exceed an absorption of 3.0 percent by weight as determined by AASHTO T84. The composite blend, minus any reclaimed asphalt pavement used, shall have a minimum degradation value of 30 as determined by the Washington State Degradation Test of 1967, or a Micro-Deval value of under 18 as determined by the AASHTO Provisional Standard available from the Owner’s Central Lab in Bangor. If the Contractor elects to use the Micro-Deval, it shall be indicated in the proposed JMF.

Aggregates shall also meet the following consensus properties. The Owner reserves the right to sample and test the composite aggregate for any of the following properties at any time.

TABLE 3 – SUPERPAVE Aggregate Consensus Properties Criteria

Estimated Traffic, Million 80 kN ESALs	ASTM D 5821 Coarse Aggregate Angularity (Minimum)		AASHTO TP33 Method A Uncompacted Void Content of Fine Aggregate (Minimum)		ASTM D 4791 (8.4) Flat and Elongated Particles (Maximum)	AASHTO T176 Clay Content/ Sand Equivalent (Minimum)
	Depth from Surface					
	<100mm	>100mm	<100mm	>100mm		
<0.3	60/60	60/60	-	-	-	45
0.3 to <1.0	65/60	60/60	40	-	-	45
1.0 to <3.0	75/60	60/60	40	40	10	45
3.0 to <10	85/80	60/60	45	40	10	45
10 to <30	95/90	80/75	45	40	10	45
30 to <100	100/100	95/90	45	45	10	50
≥ 100	100/100	100/100	45	45	10	50

ASTM D 5821 – “85/80” denotes that 85% of the coarse aggregate has one fractured face and 80% has two fractured faces.

AASHTO TP33 – Criteria are presented as percent air voids in loosely compacted fine aggregate, (U).

ASTM 4791 – Criteria are presented as maximum percent by weight of flat and elongated particles. (5:1 ratio).

401.04 – Vacant

401.05 Temperature Requirements. After the JMF is established, the temperatures of the mixture shall conform to the following tolerances:

In the truck at the mixing plant $\pm 10^{\circ} \text{C}^*$
At the Paver $\pm 10^{\circ} \text{C}^*$

* If noted in the Quality Control Plan, these may be increased or decreased due to extraordinary considerations, but temperature shall in no case vary by more than 15° C.

The JMF and the mix subsequently produced shall meet the requirements of Tables 2 and 3.

401.06 Performance Graded Asphalt Binder. PGAB shall be as specified in Special Provision 403. The PGAB shall meet the applicable requirements of AASHTO Provisional Standard MP1 – Standard Specifications for PGAB, in accordance with Section 702. The Contractor shall provide the Owner with an approved copy of the Quality Control Plan for PGAB in accordance with AASHTO PP-26.

CONSTRUCTION REQUIREMENTS

401.07 Weather and Seasonal Limitations. The State is divided into 2 paving zones as follows:

- (a) Zone 1. Areas north of U.S. Route 2 from Gilead to Bangor and north of Route 9 from Bangor to Calais.
- (b) Zone 2. Areas south of Zone 1 including the U.S. Route 2 and Route 9 boundaries.

The Contractor may place Hot Mix Asphalt Pavement for use other than a traveled way wearing course in either Zone between the dates of April 15th and November 15th, provided that the air temperature as determined by an approved thermometer (placed in the shade at the paving location) is 2° C or higher and the area to be paved is not frozen. The Contractor may place Hot Mix Asphalt Pavement as traveled way wearing course in Zone 1 between the dates of May 1st and the Saturday following October 1st and in Zone 2 between the dates of April 15th and the Saturday following October 15th, provided the air temperature determined as above is 10° C or higher. For the purposes of this Subsection, the traveled way includes truck lanes, ramps, approach roads and auxiliary lanes.

Hot Mix Asphalt Pavement used for curb, driveways, sidewalks, islands, or other incidentals is not subject to seasonal limitations, except that conditions shall be satisfactory for proper handling and finishing of the mixture. Unless otherwise specified, the Contractor shall not place Hot Mix Asphalt Pavement on a wet or frozen surface, and the air temperature shall be 2° C or higher.

401.08 Hot Mix Asphalt Plant.

401.081 General Requirements. Mixing plants shall conform to AASHTO M 156. The mixing plant shall include an efficient dust collecting system to prevent loss of fine material. The material collected may be returned to the mixture at a uniform rate and/or be discarded.

- (a) Truck Scales. When the bituminous mixture is to be weighted on scales meeting the requirements of Section 109 – Measurement and Payment, the scales shall be inspected and sealed by the State Sealer as often as the Owner deems necessary to verify their accuracy.
- (b) Performance Graded Asphalt Binder. The Contractor shall provide a valve for sampling the bituminous material, located in a circulating feed line connecting the storage tank with the mixing plant or in a line of the storage circulation system. The valve shall be in a readily accessible location offering protection from damage. The Contractor shall maintain this valve in a workable condition and provide a drainage receptacle.

401.083 Automation of Batching. Batch plants shall be automated for weighing, recycling and the monitoring system. In the case of a malfunction of the printing system, the requirements of Subsection 109.013(c) will apply.

The batch plant shall accurately proportion the various materials in the proper order by weight. The entire batching and mixing cycle shall be continuous and shall not require any manual operations. The batch plant shall use auxiliary interlock circuits to trigger an audible alarm whenever an error exceeding the acceptable tolerance occurs. Along with the alarm, the printer shall print an asterisk on the delivery slip in the same row containing the out-of-tolerance weight. The automatic proportioning system shall be capable of consistently delivering material within the full range of batch sizes.

Tolerances are based on the total batch weight of the Hot Mix Asphalt Pavement. The batch plant shall be able to automatically or manually adjust for all desired batch sizes. The first or last bin drawn shall be the sand bin. Allowable tolerances are as follows:

Each aggregate component	± 2.5 percent from the cumulative target, each bin
Last Bin Drawn	± 1.5 percent
Mineral Filler	± 0.5 percent
Performance Graded Asphalt Binder	± .25 percent, -.15 percent
Zero Return (aggr.)	± 0.5 percent
Zero Return (bit. Material)	± 0.1 percent

All plants shall be equipped with an approved digital recording device. The delivery slip load ticket shall contain information required under 1 through 4 of Section 109.01(f), and sections (a) and (b) of 109.012.

401.085 Drum Plant Recordation of Proportions. The plant shall utilize an approved recordation system. In the case of a malfunction of this recordation system, the Contractor may continue production for up to two working days while the system is repaired, after which time production shall cease until repairs are completed. The recorder shall simultaneously record the accumulated weights of the dry aggregates, the mineral filler (if added separately) and the Performance Graded Asphalt Binder, all at 5 minute intervals during production and on demand, unless the Owner approves otherwise. The printed record shall include the actual Performance Graded Asphalt Binder content quantity as a percentage of the total mixture weight. The maximum resolution shall be 90 kg of dry aggregate, 9 kg of mineral filler, 9 kg of Performance Graded Asphalt Binder, and 0.1 percent for Performance Graded Asphalt Binder content. The printout shall indicate the amount of moisture programmed into the moisture compensation by total weight. All printed records shall show the day, month, year, and the time to the nearest minute when the printout was generated. The Contractor shall provide the Owner with a clear and legible copy of the recordings at the end of each day.

401.09 Hauling Equipment. Trucks for hauling Hot Mix Asphalt Pavement shall have tight, clean, smooth metal dump bodies which have been thinly coated with a small amount of lime solution or an approved soap solution or detergent to prevent the mixture from adhering to the bodies.

All truck dump bodies shall have a cover of canvas or other water repellent material capable of heat retention which completely covers the mixture. The cover shall be securely fastened on the loaded truck except when unloading.

All truck bodies shall have an opening on both sides which will accommodate a thermometer stem. The opening shall be located near the midpoint of the body, at least 300 mm above the bed.

401.10 Pavers. Pavers shall be self-contained, self-propelled units with an activated screen (heated if necessary) capable of placing courses of Hot Mix Asphalt Pavement in lane widths on the main line, or shoulder width for shoulders and similar construction.

The Contractor shall place Hot Mix Asphalt Pavement on the main line with a paver using an automatic grade and slope controlled screed, unless otherwise authorized by the Owner. The controls shall automatically adjust the screed and increase or decrease the layer thickness to compensate for irregularities in the preceding course. The controls shall maintain the proper transverse slope and be readily adjustable so that transitions and superelevated curves can be properly paved. The controls shall operate from a fixed or moving reference such as a grade wire or ski type device (floating beam) with a minimum length of 9 M, except that a 12 M ski shall be used on Expressway projects.

The Contractor shall operate the paver at speeds which produce a uniform mat. The paver shall have a receiving hopper with sufficient capacity for a uniform spreading operation and a distribution system to place the mixture uniformly, without segregation in front of the screed. The screed assembly shall produce a finished surface of the required evenness and texture without tearing, shoving, or gouging the mixture. Pavers with extendible screeds shall have auger extensions and tunnel extenders as necessary.

The Contractor shall have the paver at the project site sufficiently before the start of paving operations to be inspected and approved by the Owner. The Contractor shall repair or replace any paver found worn or defective, either before or during placement, to the satisfaction of the Owner.

401.11 Rollers. Rollers shall be static steel, pneumatic tire, or approved vibrator type. Rollers shall be in good mechanical condition, capable of starting and stopping smoothly, and be free from backlash when reversing direction. Rollers shall be equipped and operated in such a way as to prevent the picking up of hot

mixed material by the roller surface. Use of rollers which result in crushing of the aggregate or displacement of the mixture will not be permitted. Any Hot Mix Asphalt Pavement that becomes loose, broken, contaminated, shows an excess or deficiency of Performance Graded Asphalt Binder, or is in any other way defective shall be removed and replaced at no additional cost with fresh Hot Mix Asphalt Pavement which shall be immediately compacted to conform with the adjacent area.

The type of rollers to be used and their relative position in the compaction sequence shall generally be the Contractor's option, provided specification densities are attained and with the following requirements:

- 1) At least one roller shall be pneumatic-tired on bridges and variable depth courses as well as the first lift of pavement over gravel or a reclaimed pavement or other irregular surface.
- 2) Compaction with a vibratory or steel wheel roller shall precede pneumatic-tired rolling, unless otherwise authorized by the Owner.
- 3) Vibratory rollers shall not be operated in the vibratory mode when checking or cracking of the mat occurs, or on bridge decks.
- 4) Any method which results in cracking or checking of the mat will be discontinued, and corrective action taken.

The maximum operating speed for a steel wheel roller shall not exceed the manufacturer's recommendations.

401.111 Surface Tolerances. The Owner will check surface tolerance with a 4.9 m straightedge or string line placed parallel to the centerline of pavement and with a 3 m straightedge or string line placed transverse to the centerline of pavement. The Contractor shall correct variations exceeding 6 mm by removing defective work and replacing it with new material as directed by the Owner. The Contractor shall furnish a 3 m straightedge for the Owner's use.

401.12 Conditioning of Existing Surface. The Contractor shall thoroughly clean the surface upon which Hot Mix Asphalt Pavement is to be placed of all objectionable material. When the surface of the existing base or pavement is irregular, the Contractor shall bring it to uniform grade and cross section.

401.13 Hot Mix Asphalt Material Documentation. The Contractor and the Owner shall agree on the amount of Hot Mix Asphalt Pavement that has been placed each day.

401.14 Preparation of Aggregates. The Contractor shall dry and heat the aggregates for the mixture to the required temperature. The Contractor shall properly adjust flames to avoid physical damage to the aggregate and to avoid depositing soot on the aggregate.

401.15 Mixing. The Contractor shall combine the dried aggregate in the mixer in the amount of each fraction of aggregate required to meet the JMF. The Contractor shall measure the amount of PGAB and introduce it into the mixer in the amount specified by the JMF.

The Contractor shall produce the mixture at the temperature established by the JMF.

The Contractor shall dry the aggregate sufficiently so that the mixture will not flush, foam excessively, or displace excessively under the action of the rollers. The Contractor shall introduce the aggregate into the mixer at a temperature of not more than 14° C above the temperature at which the viscosity of the bituminous material being used is 0.150 Pas.

The Contractor shall store and introduce into the mixer the Performance Graded Asphalt Binder at a uniformly maintained temperature at which the viscosity of the material is between 0.150 Pas and 0.300 Pas.

The aggregate shall be completely and uniformly coated with a thorough distribution of the PGAB. The Contractor shall determine the wet mixing time for each plant and for each type of aggregate used.

401.16 Spreading and Finishing. On areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the Contractor shall spread, rake, and lute the mixture with hand tools to provide the required compacted thickness.

On the roads opened to two way traffic, the Contractor shall place each course over the full width of the traveled way section being paved that day, unless otherwise approved by the Owner.

401.17 Compaction. Immediately after the Hot Mix Asphalt Pavement has been spread, struck off, and any surface irregularities adjusted, the Contractor shall thoroughly and uniformly compact the mixture by rolling.

The Contractor shall roll the surface when the mixture is in the proper condition and when the rolling does not cause undue displacement, cracking, or shoving. The Contractor shall prevent adhesion of the mixture to the rollers or vibrating compactors without the use of oil.

The Contractor shall immediately correct any displacement occurring as a result of the reversing of the direction of a roller or from other causes to the satisfaction of the Owner. Any operation other than placement of variable depth shim course that results in breakdown of the aggregate shall be discontinued.

Along forms, curbs, headers, walls, and other places not accessible to the roller, the Contractor shall thoroughly compact the mixture with mechanical vibrating compactors. The Contractor shall only use hand tamping in areas inaccessible to all other compaction equipment. On depressed areas, the Contractor may use a trench roller or cleated compression strips under a roller to transmit compression to the depressed area.

401.18 Joints. The Contractor shall construct wearing course transverse joints in such a manner that minimum tolerances shown in section 401.111 are met when measured with a straightedge.

The paver shall always maintain a uniform head of material during the joint construction. The bituminous mix shall be free of segregation and meet temperature requirements. Transverse joints of the wearing course shall be straight and neatly trimmed. The Contractor may form a vertical face exposing the full depth of the course by inserting a header, by breaking the bond with the underlying course, or by cutting back with hand tools. The Owner may allow feathered or "lap" joints on lower courses or when matching existing low type pavements.

The Contractor shall apply a coating of emulsified asphalt immediately prior to paving all joints, except those formed by pavers operating in echelon. The Contractor shall use an approved spray apparatus designed for covering a narrow surface. The Owner may approve application by a brush for small surfaces, or in the event of a malfunction of the spray apparatus, but for a period of not more than one working day.

Where pavement under this Contract joins an existing pavement of when the Owner directs, the Contractor shall cut the existing pavement along a smooth line, producing a neat, even, vertical joint. The Owner will not permit broken or raveled edges. The cost of all work necessary for the preparation of joints is incidental to related Contract items.

401.19 Quality Control Method A & B.

The Contractor shall operate in accordance with the approved Quality Control Plan (QCP) to assure a product meeting the Contract requirements. The QCP shall meet the requirements of 106.031 and these Special

Provisions. The Contractor shall not begin paving operations until the QCP is approved in writing by the Owner.

Prior to placing any mix, the Owner and the Contractor shall hold a Pre-paving conference to discuss the paving schedule, source of mix, type and amount of equipment to be used, sequence of paving pattern, rate of mix supply, and traffic control. All field and plant supervisors including the responsible onsite paving supervisor shall attend this meeting.

The QCP shall address all elements which affect the quality of the Plant Mix Pavement including, but not limited to, the following:

- (a) JMF(s)
- (b) Hot asphalt mix plant details
- (c) Stockpile Management (to include provisions for a minimum 2 day stockpile)
- (d) Make & type of paver(s)
- (e) Make & type of rollers including weight, weight per inch of steel wheels, and average contact pressure for pneumatic tired rollers
- (f) Name of QCP Administrator, and certification number
- (g) Name of Process Control Technician(s), and certification number(s)
- (h) Name of Quality Control Technician(s), and certification number(s)
- (i) Mixing & transportation including process for ensuring that truck bodies are clean and free of debris or contamination that could adversely affect the finished pavement.
- (j) Frequency of and tests for Quality Control pavement
- (k) Laydown operations including longitudinal joint construction, procedures for avoiding paving in inclement weather, tacking of all joints, methods to ensure that segregation is minimized, procedures to determine the maximum rolling and paving speeds based on best engineering practices as well as past experience in achieving the best possible rideability of the pavement.
- (l) Examples of Quality Control Forms
- (m) Process for compacting paved shoulders and traveled way for method B projects
- (n) Silo management and details (can show storage for use on project of up to 36 hours)
- (o) Provisions for varying mix temperature due to extraordinary conditions.
- (p) Name and responsibilities of the Responsible onsite Paving Supervisor

The QCP shall include the following technicians together with these minimum requirements:

- (a) QCP Administrator – A qualified individual shall administer the QCP. The QCP Administrator must be a full-time employee of or a consultant engaged by the Contractor or paving subcontractor. The QCP Administrator shall have full authority to institute any and all actions necessary for the successful operation of the QCP. The QCP Administrator (or its designee in the QCP Administrator's absence) shall be available to communicate with the Owner at all times. The QCP Administrator shall be certified as a Plant Technician or Paving Technician certified by the New England Transportation Technician Certification Program.
- (b) Process Control Technician(s) (PCT) shall utilize test results and other quality control practices to assure the quality of aggregates and other mix components and control proportioning to meet the JMF(s). The PCT shall periodically inspect all equipment used in mixing to assure it is operating properly and that mixing conforms to the mix design(s) and other Contract requirements. The QCP shall detail how these duties and responsibilities are to be accomplished and documented and whether more than one PCT is required. The Plan shall include the criteria to be utilized by the PCT to correct or reject unsatisfactory materials. The PCT shall be certified as a Plant Technician by the New England Transportation Certification Program.

- (c) Quality Control Technician(s) (QCT) shall perform and utilize quality control tests at the job site to assure that delivered materials meet the requirements of the JMF(s). The QCT shall inspect all equipment utilized in transporting, laydown, and compacting to assure it is operating properly and that all laydown and compaction conform to the Contract requirements. The QCP shall detail how these duties and responsibilities are to be accomplished and documented, and whether more than one QCT is required. The QCP shall include the criteria utilized by the QCT to correct or reject unsatisfactory materials. The QCT shall be certified as a Paving Technician by the New England Transportation Technician Certification Program.

The QCP shall detail the coordination of the activities of the Plan Administrator, the PCT and the QCT. The project Superintendent shall be named in the QCP, and his responsibilities for successful implementation of the QCP shall be outlined.

The Contractor shall sample, test, and evaluate Hot Mix Asphalt Pavement in accordance with the following minimum frequencies:

Table 4: MINIMUM QUALITY CONTROL FREQUENCIES

Test or Action	Frequency	Test Method
Temperature of mix	6 per day at street and plant	-
Temperature of Mat	4 per day	-
% TMD (Surface)	1 per 150 Mg	ASTM D-2950*
% TMD (Base)	1 per 600 Mg	AASHTO T-166
Fines/Effective Binder	1 per 1200 Mg	AASHTO TP-4
Gradation	1 per 600 Mg	AASHTO T-30
PGAB content	1 per 600 Mg	AASHTO T-164, T-287 or TP 53
Voids at N_{design}	1 per 600 Mg	AASHTO TP-4
Voids in Mineral Aggregate at N_{design}	1 per 600 Mg	AASHTO TP-4
Rice Specific Gravity	1 per 600 Mg	AASHTO T-209
Coarse Aggregate Angularity	1 per 6000 Mg	ASTM D 5821
Flat and Elongated Particles	1 per 6000 Mg	ASTM D-4791
Fine Aggregate Angularity	1 per 6000 Mg	AASHTO TP33

* May be modified according to the MDOT's policy on file at the Central Lab in Bangor.

The Contractor may utilize innovative equipment or techniques not addressed by the Contract documents to produce or monitor the production of the mix, subject to approval by the Owner.

The Contractor shall record all Hot Mix Asphalt Pavement plant test results in writing, signed by the appropriate technician and present them to the Owner by 10:00 AM on the next working day, except when otherwise noted in the QCP due to local restrictions. The Contractor shall make density test results, including randomly sampled densities, available to, and summaries of each day's results shall be recorded and signed by the QCT and presented to the Owner by 10:00 AM the next working day.

The Contractor shall have a testing lab at the plant site, equipped with all testing equipment necessary to complete the tests in Table 4. The Contractor shall locate an approved SHRP Gyrotory Compactor at the plant testing lab or within 30 minutes of the plant site.

The Contractor shall fill all holes in the pavement resulting from cutting cores by the Contractor or the Owner with an acceptable mixture no later than the following working day. Before filling, the Contractor shall carefully clean the holes and apply a coating of emulsified asphalt. On surface courses, cores shall not be cut except for calibration of the Nuclear Density Gauge, or as directed by QA testing by the Owner. On a daily basis, the Contractor shall perform nuclear density testing across the mat being placed, at 300 mm intervals. If the values vary by more than 2.0% from the mean, the Contractor shall make adjustments until the inconsistencies are remedied.

The Contractor shall monitor plant production using control charts as specified in Section 106. If plotted test results indicate a production problem, the Contractor shall notify the Owner and take corrective action acceptable to the Owner. The Contractor shall keep control charts up to date and available for review by the Owner at any time.

The Contractor may construct a pavement test strip on a given project at the option of the Contractor for each individual JMF. Prior to test strip placement the Contractor shall deliver a written notice to the Owner notifying that a test strip will be scheduled. Prior to placement of the test strip, a passing verification test is required.

The test strip shall not exceed 800 M. The quantity of Hot Mix Asphalt produced for the test strip shall not exceed 700 MG, 4 hours production, or 4% of the total quantity for the project, as determined by the Owner.

The test strip is intended to allow the Contractor to establish rolling patterns to achieve optimum density for the mat being laid. The Owner will not test the first third of the mat, allowing the plant to "balance itself". The Owner will calibrate thin lift densometers against cut cores. For surface mixes, the Owner will select 3 test sites and take 4 shots at each site. For base and binder mixes, 3 cores shall be run for density verification. The Contractor shall not commence full production until the calibrations are complete and the test strip has attained its minimum values for percent voids and percent TMD.

Should the test strip fail to meet an average density of 89% or greater (minimum of 3 tests, maximum of 7 including re-tests) or should the volumetrics, based on QC results, be outside of the 3-6% range, the Owner will reject the test strip. The Contractor shall remove and replace rejected test strips at their expense. The test strip shall be considered part of the project pavement and no separate payment will be made.

The Contractor shall cease paving operations whenever one of the following occurs on a lot in progress:

- (1) The Pay Factor (which will be used for QA purposes only) for VMA, Voids @ N_d , Percent PGAB, composite gradation, VFB, fines to effective binder or density using all available tests is less than 0.90.
- (2) The Coarse Aggregate Angularity or Fine Aggregate Angularity value falls below the requirements of Table 3 for the design traffic level.
- (3) The first 2 control tests for the lot fall outside the upper or lower limits.
- (4) The Flat and Elongated Particles value exceeds 10 percent by ASTM D-4791.
- (5) There is any visible damage to the aggregate due to over-densification other than on variable depth shim courses.
- (6) The Contractor fails to follow the approved QCP.

Paving operations shall not resume until the Contractor and the Owner determine that material meeting the Contract requirements will be produced. The Owner will consider corrective action acceptable if the Pay Factor for the failing property increases. If the Owner determines that the resumption of production involves a significant change to the production process, the current lot will be terminated and a new lot will begin.

401.20 Quality Assurance.

Method A

This method utilizes Quality Level Analysis and Pay Factor specifications. However, the pay factor shall be utilized to evaluate pavement performance only. Payment for all material and labor to place the payment shall be included in the Lump Sum contract. No separate payment will be made.

For asphalt pavement designated for acceptance under Quality Assurance (QA) provisions, the Owner will sample once per subplot on a statistically random basis, test, and evaluate in accordance with the following Acceptance Criteria:

Table 5: ACCEPTANCE CRITERIA

PROPERTIES	POINT OF SAMPLING	LOT SIZE	SUBLOT SIZE	TEST METHOD
Gradation	Paver Hopper	JMF*	1200 Mg	AASHTO T-30
PGAB Content	Paver Hopper	JMF*	1200 Mg	AASHTO TP-53
% TMD (Surface)	Mat behind all Rollers	JMF*	300 Mg	ASTM-2950/ AASHTO T-166
% TMD (Base or Binder)	Mat behind all Rollers	JMF*	600 Mg	AASHTO T-166
Air Voids at N_d	Paver Hopper	JMF*	1200 Mg	AASHTO TP-4
Voids in Mineral Aggregate at N_d	Paver Hopper	JMF*	1200 Mg	AASHTO TP-4
Fines to Effective Binder	Paver Hopper	JMF*	1200 Mg	AASHTO TP-4
Voids Filled with Binder	Paver Hopper	JMF*	1200 Mg	AASHTO TP-4

* Not to exceed 6,000 Mg, unless an unplanned overrun less than 2400 MG, or agreed to at the Pre-Construction Conference.

On the first day of production the Owner will take 3 random samples which will be used to calculate the quality level of the in-place material in the event the lot is terminated prematurely. Only 1 of the 3 will be for tested, the other 2 will be held onsite until at least 3 random samples have been taken, at which time the other 2 will be discarded.

(a) Lot Size. For purposes of evaluating all acceptance test properties, a lot shall consist of the total quantity represented by each item listed under the lot size heading in the table above. Each lot will be divided into at least 3 sublots, 5 where possible.

(b) Sublot size. The quantity represented by each sample will constitute a subplot. The size of each subplot shall be as listed under the subplot size heading in the table above. If there is insufficient quantity in a lot to make up at least three sublots, then the lot quantity will be divided into three equal sublots.

If there is less than one half of a subplot remaining at the end, then it shall be combined with the previous subplot. If there is more than one half subplot remaining at the end, then it shall constitute the last subplot and shall be represented by test results.

(c) Rejection by Contractor. The Contractor may, prior to sampling, elect to remove any defective material and replace it with new material at no expense to the Owner. The Owner will sample, test, and evaluate any such new material for acceptance. The Owner will review any test results for density below 90%, and areas found to be deficient shall be isolated and 3 random tests taken. If the resultant Pay Factor falls at or below 0.75, the Contractor shall remove and replace the material for the full lane width for a length of no less than 50 Meters at no expense to the Owner.

(d) Acceptance Testing. The Owner will obtain samples of Hot Mix Asphalt Pavement in conformance with AASHTO T168 – Sampling Bituminous Paving Mixtures. The Owner will take the sample randomly within each subplot. Target values shall be as specified in the JMF. The Owner will use the following Table for calculating Pay Factors for gradation, PGAB content, air voids at N_d , VMA, Fines to Effective Binder and VFB.

Table 6: GRADATION, VOLUMETRIC AND ASPHALT CEMENT ACCEPTANCE LIMITS

Property	USL and LSL
Passing 4.75 mm and larger sieves	Target \pm 7 percent
Passing 2.36 mm to 1.18 mm sieves	Target \pm 4 percent
Passing 0.60 mm	Target \pm 3 percent
Passing 0.30 mm to .075 mm sieve	Target \pm 2 percent
PGAB Content	Target \pm 0.4 percent
Air Voids	Target \pm 1.5 percent
Fines to Effective Binder	0.6% to 1.4%
Voids in the Mineral Aggregate	JMF Target \pm 1.5% but not more than 0.5% below the table 2 Min. Value
Voids Filled with Binder	Target \pm 5%

Prior to paving, the Contractor shall determine whether testing of the surface for density QA will be done with cores or the Nuclear Density Gauge. If the Owner tests with the Nuclear Method, then the following table shall apply:

Table 7a: Density Acceptance Limits

	TARGET	LSL	USL
% of Maximum Theoretical Density	94.5	92.0	97.0

The Owner will designate a control section of pavement approximately 150 m long at the start of the paving operations. Within the control section at least three locations will be tested at the same offset at approximately a 2 M spacing to calibrate the nuclear density gauge. After placement of pavement, the Contractor shall cool the pavement to be tested by using ice and promptly cut the necessary calibration cores. After cooling to 20° C, the Contractor shall remove the cores using a core removing tool to assure minimum damage to the core. The Owner will adjust the nuclear density gauge to reflect the average of the cores. The Owner reserves the right to designate a new control section at any time. When nuclear testing is performed at locations outside normal paving and traffic control areas, the Contractor shall furnish a flagger and other necessary safety devices to protect personnel and equipment.

For base of binder courses, or for surface course when the nuclear density gauge is not available and the Owner so directs, the Contractor shall cut cores within 24 hours of placement of the pavement, or by the end of the next working day.

If the Owner tests with the Core Method then the following Table shall apply:

Table 7b: Density Acceptance Limits

	TARGET	LSL	USL
% of Maximum Theoretical Density	95.0	92.5	97.5

The Owner will measure pavement density on the compacted wearing surface using core samples tested according to AASHTO T-166. The Owner will randomly determine core locations. The Contractor shall cut cores at no additional cost to the Owner within 24 hours of placement of the pavement, and immediately give them to the Owner. At the time of sampling, the Contractor and the Owner shall mutually determine if a core is damaged. If it is determined that the core(s) is damaged, the Contractor shall cut new core(s) adjacent to the initial sample. In the Owner's presence, the Contractor may saw-cut the bottom of the core onsite without disturbing the layer being tested to remove lower layers of Hot Mix Asphalt Pavement, gravel, or RAP. No recuts are allowed at a test location after the core has been tested.

The minimum acceptable density for shoulders shall be 90.0% unless waived by the Owner due to local conditions that make densification to this point detrimental to the finished pavement.

Method B

Method B utilizes Product Verification testing to determine the quality of the material incorporated into the project. The Hot Mix Asphalt Pavement (other than that placed outside the traveled way and shoulders) shall meet the material properties in Tables 1 through 3. Aggregates and Mix shall meet the Consensus and Volumetric properties in Table 8 and Section 401.03, Aggregates, utilizing the testing methods and sampling procedures in Table 5.

For the traveled way density will be tested with 3 random cores, and statistically evaluated for Pay Factors with a USL of 98.0% and an LSL of 92.0%. If the resultant Pay Factor is 0.75 or below, the Contractor shall remove and replace the material with mix meeting the specifications at no additional cost to the Owner.

Only the Owner shall be allowed to dispute whether the test results reflect the true quality of the mix.

Unless otherwise noted, the Owner will verify density by inspection to ensure that the proper compaction procedures are complied with. The Owner may test for density to ensure that the Contractor's method attains acceptable results. At any time, the Owner may take samples from the source of production to determine the properties shown in Table 8, Section 401.03, Aggregates, or will verify these properties with test results from another project done during the same time period.

Table 8: GRADATION, VOLUMETRIC AND PGAB CONTENT VERIFICATION LIMITS
(METHOD B)

	USL and LSL		
	Mainline	Shoulder	Drives & Sidewalks
Percent Passing 4.75 mm and larger sieves	Target \pm 7	Target \pm 7	Target \pm 7
Percent Passing 2.36 mm to 1.18 mm sieves	Target \pm 5	Target \pm 5	Target \pm 5
Percent Passing 0.60 mm	Target \pm 4	Target \pm 4	Target \pm 4
Percent Passing 0.30 mm to 0.75 mm sieve	Target \pm 3	Target \pm 3	Target \pm 3
PGAB Content	Target \pm 0.5	Target \pm 0.5	Target \pm 0.5
Air Voids	4.0% \pm 2.0	4.0% \pm 2.0	Not Applicable
Fines to Effective Binder	0.6% to 1.6%	0.6% to 1.6%	Not Applicable
Voids in the Mineral Aggregate	JMF Target \pm 1.5%*	JMF Target \pm 1.5%*	Not Applicable
Voids Filled with Binder	Target \pm 5%	Target \pm 5%	Not Applicable

* But not more than 0.5% below the Table 2 Min. Value

For PGAB Content, Gradation, and Volumetric properties on items covered under Method B, the Owner may take 3 or more random samples from the material delivered to the project. The Owner may elect to test one or more of these samples to evaluate the quality of the mix. If there is concern about the quality, the Owner will test 3 or more random samples to determine a Pay Factor for each property using Table 8 USLs and LSLs. The Owner may reject material with a 0.75 pay factor or less. If the PF is less than 1.00 but greater than 0.75, price adjustments may be made accordingly. If the PF is 1.00 or greater the Owner will pay the full contract price.

401.21 Method of Measurement and Payment. All material, equipment and labor required to produce, place and test the asphalt pavement shall be included in the Lump Sum contract except testing by the independent testing laboratory hired by the Owner. No quantity measurement will be made for any pavement placed under this contract.

401.22 Basis of Payment. Payment for all paving activity shall be included in the Project Lump Sum contract price.

This Work shall include all labor, equipment, materials, and incidentals necessary to meet all related Contract requirements, including design of the JMF, implementation of the QCP, obtaining core samples, filling core holes, applying emulsified asphalt to joints, and providing testing facilities and equipment. Cleaning objectionable material from the pavement and furnishing and applying bituminous material to joints and contact surfaces is incidental.

No separate payment will be made for any pavement work under this Contract.

401.222 Pay Factor (PF) (Method A Only). The Owner will use density, Performance Graded Asphalt Binder content, voids @ N_d , VMA, VFB, F/B^c, and the screen sizes listed below (Table 9) for the type of material represented in the JMF. The Owner will evaluate materials using the following price adjustment factors under Subsection 106.033 for QA purposes only and no additional payment will be based on these calculations.

Table 9: Table of Gradation Composite “f” Factors
(Method A)

Constituent		“f” Factor				
		25 mm	19 mm	12.5 mm	9.5 mm Surface	9.5 mm Other
Gradation	25 mm	4	-	-	-	-
	19 mm		4	-	-	-
	12.5 mm			4	-	-
	9.50 mm				4	4
	2.36 mm	6	6	6	6	6
	1.18 mm					
	0.60 mm	2	2	2	2	2
	0.30 mm	2	2	2	2	2
	0.075 mm	6	6	6	6	6

For each lot of material, the Owner will determine a price adjustment as follows:

Gradation. The Owner will determine a composite pay factor (PF) using applicable price adjustment factors “f” from Table 9 and acceptance limits from Table 6. The Owner will not make price adjustments for gradations, but will monitor them as a shutdown criteria.

VFB and Fines to Effective Binder. The Owner will determine a pay factor (PF) using acceptance limits from Table 6. The Owner will not make price adjustments for VFB or Fines to Effective Binder, but will monitor them as a shutdown criteria.

Density. For mixes having a density requirement, the Owner will determine a Pay Factor using acceptance limits from Table 7a or 7b.

PGAB Content, VMA and Air Voids. For mixes having a Volumetric requirement, the Owner will determine a Pay Factor using acceptance limits from Table 6.

If any single Pay Factor for PGAB Content, VMA, Air Voids or Density falls below 0.75, the Owner will reject the material.

401.223 Process for Dispute Resolution (Method A Only).

The Owner will take a split for each QA test random sample, including mix samples for PGAB content, volumetrics and gradation, and label and store them to allow at least 2 working days for the Contractor to notify the Owner in writing of any disputes. At the time of sampling, the Contractor may also take a split sample of the material.

(a) PGAB content. To contest PGAB content within a subplot the Contractor must run its split of the original sample. If the Contractor tests its split and the results are equal to or greater than the allowable tolerances in Table 10, and notifies the Owner in writing within 2 working days of receiving the QA test results, the Owner will retest for PGAB content by the ignition method. If the re-test result is within the allowable tolerance shown in Table 10, the original test result will be used. If the re-test is equal to or greater than the allowable tolerances from Table 10 the new value will be used to calculate PGAB Content, VMA, VFB and Fines to Effective Binder.

(b) Density. To contest a nuclear density reading within a subplot, 1) the Contractor's nuclear gauge must have been calibrated using the same cores as the QA test gauge, and 2) the QC test must have been taken at the same location, and 3) the difference must have been greater than the tolerance allowed in Table 10. If the difference is greater, the Contractor may request a new reading be taken by the QA Technician within 10 meters at the same offset from centerline. If this result is within Table 10 tolerance, the Owner will use the initial QA test. If the resulting density reading differs more than allowed in Table 10, the Owner will use the second reading. If the difference is less than the tolerance allowed in Table 10, the Owner will use the original reading.

If the Contractor and the Owner believe that the mat being tested may be 5 mm less than the designated thickness or thinner, the Contractor may cut a core in the same location as the original test. If the core is found to be 5 mm or more thinner than the designated thickness, then the Owner will test the core. If the density results exceed the tolerances allowed in Table 10, then the Owner will substitute the core value for the nuclear value. Re-testing may only take place after the area is opened to traffic if approved by the Owner. On any pavement thickness found to be less than 30 mm, the Owner will determine density using the core.

Where the Owner tests for density by the core method, no disputes will be allowed unless based on evidence that the results are inaccurate, as reasonably determined by the Owner.

(c) Volumetric. If the Contractor believes that the Owner's test results vary significantly from the Contractor's results, the Contractor may dispute the Owner's results by testing their split of the original sample. If the Contractor's results vary from the Owner's results by more than the tolerance in Table 10, and the Owner is notified in writing within at least 2 working days of the Contractor receiving QA test results, the Owner will

re-test the remaining split of the original sample. If the Owner's re-test is within the allowable tolerance shown in Table 10, the original test shall stand. If the re-test is outside the allowable tolerances from Table 10 but is within the Table 10 tolerance of the Contractor's test, the Owner will use the second value.

When the Contractor has initiated 3 disputes that have not been overturned, further disputes resulting in no change will be paid for by the Contractor at the rates established by the Owner.

Table 10. Dispute Resolution Variance Limits

PGAB Content	$\pm 0.3\%$ *
Density	$\pm 1.0\%$
Voids @ N_d	$\pm 0.8\%$
VMA	$\pm 0.8\%$

* 0.4% will be used if the Contractor uses any method other than TP53.

END OF SECTION-APPENDIX A

SECTION 321600 – CURBS AND SIDEWALKS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Concrete, Paver, Brick or Bituminous Sidewalks
- B. Granite Curb
- C. Bituminous Curb
- D. Concrete Curb
- E. Exterior Plaza Areas or Special Materials for Walks
- F. Refer to the contract drawings, Division 01, and the bid form for clarification and distinction between base bid and bid alternate work.

1.2 RELATED SECTIONS

- A. Section 311000 - Site Clearing
- B. Section 312000 – Earth Moving
- C. Section 321100 - Base Courses
- D. Section 321723.13 – Painted Pavement Markings
- E. State Highway Department Standard Specifications
- F. Construction Documents.

1.3 SECTION EXCLUDES STRUCTURAL SLABS AT ENTRANCES

- A. Structural slabs are entryway areas consisting of a slab supported by a foundation contiguous with the building foundation. Refer to contract documents for the limit of work at the entryway.

1.4 REFERENCES

- A. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

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- B. ANSI/ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural construction.
- C. ANSI/ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- D. ASTM C33 - Concrete Aggregates.
- E. ASTM C94 - Ready Mix Concrete.
- F. ASTM C150 - Portland Cement
- G. ASTM C260 - Air-Entraining Admixtures for Concrete.
- H. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.
- I. ASTM C494 - Chemical Admixtures for Concrete.
- J. FA TT-C-800 - Curing Compound, Concrete, for New and Existing Surfaces.
- K. MDOT and New Hampshire specifications for Highway and Bridge construction, current edition.

1.5 PERFORMANCE REQUIREMENTS

- A. Contractor shall maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize temporary striping, flagmen, barricades, warning signs, and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Coat forms with non-staining type coating that will not discolor or deface surface of concrete.
- B. Welded Wire Mesh: Welded plain cold-drawn steel wire fabric, ASTM 185. Furnish in flat sheets, not rolls, unless otherwise acceptable to Owner.
- C. Concrete Materials: Comply with requirements of applicable Division 3 sections for concrete materials, admixtures, bonding materials, curing materials, and others as required. Any concrete outside of the building and not a structural slab shall be part of the Sitework for the project.

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- D. Joint Fillers: Resilient pre-molded bituminous impregnated fiberboard units complying with ASTM D 1751 FS HH-F-341, Type II, Class A; or AASHTO M 153, Type I.
- E. Joint Sealers: Non-priming, pourable, self-leveling polyurethane. Acceptable sealants are Sonneborn "Sonolastic Paving Joint Sealant", Sonneborn "Sonomeric CT 1 Sealant", Sonneborn "Sonomeric CT 2 Sealant", Mameco "Vulken 45", or Woodmont Products "Chem-Caulk".
- F. Granite Curb: Sloped granite curb shall be Type "V", meeting the requirements of the State of New Hampshire Type "E" sloped granite curb, except where Type "V" vertical curb, meeting the requirements of MDOT Specification 609, is required and specifically shown on the contract drawings. All curb shall be of granite mined and cut in the United States of America. Type 1 granite headstones shall be used at all catch basin inlets along the access drive gutter lines. Granite at all ADA ramps shall be Type 1 with a ¼" reveal. Type V curb is not permitted for tip downs or to directly abut Type 1 curb in any area. An NHDOT Type 1 to Type V transition stone shall be used in these areas.
- G. Bituminous Curb shall be used where required on the Contract Drawings and shall be installed in accordance with Section 609 of the MDOT specifications. Fiberglass resin shall be used in all curb. Coatings pursuant to MDOT specifications (seal coat) shall be provided for all bituminous curb.
- H. Aggregates subbase gravels and base gravels (if appropriate) for sidewalks shall meet the requirements of Section 32 11 00 of these specifications.
- I. Asphaltic concrete pavement for sidewalks shall meet the requirements of Section 32 12 16 of these specifications.
- J. Aggregate Base: Material for aggregate base course shall be a graded, granular, non-frost susceptible, free-draining material, consisting of either durable stone and coarse sand or of blast furnace slag, practically free from loam and clay, and which can be readily compacted to form a stable foundation.
 - 1. Material shall conform to MDOT Specifications Section 703.06, "Aggregate for Base" Type A gravel.
- K. Sand:
 - 1. Sand for setting bed and for between pavers shall be a clean, washed river or bank sand conforming to ASTM C 144.
 - 2. Sand shall be supplied by a single source. Source of supply shall not be changed during course of project without written permission of the Engineer.
- L. Bituminous Setting Bed:
 - 1. Asphalt cement to be used in the bituminous setting bed shall conform to ASTM D 3381. Viscosity grade shall be A.C. 10 or A.C. 20.
 - 2. Fine aggregate to be used in the bituminous setting bed shall be clean, hard sand with durable particles and free from adherent coating, lumps of clay, alkali salts, and organic matter. Aggregate shall be uniformly graded from "coarse" to "fine" with 100% by weight

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- passing the No. 4 sieve and shall meet the gradation requirements when tested in accordance with ASTM C 136.
3. Fine aggregate shall be dried and shall be combined with hot asphalt cement, and the mix shall be heated to approximately 300° F. at an asphalt plant. The approximate proportion of materials shall be 7% cement asphalt and 93% fine aggregate. Each tone of material shall be apportioned by weight in the approximate ratio of 145 lb. Asphalt to 1,855 lb. Sand. The Contractor shall determine the exact proportions to produce the best possible mixture for construction of the bituminous setting bed to meet specified requirements.
- M. Concrete Pavers: Pavers shall be of a color selected by the Owner and, where necessary, comply with the ADA requirements for tactile warning strips.
1. Pavers shall have an average compressive strength of 5000 psi.
 2. Water absorption shall be less than 5%.
 3. No weight loss or visual signs of deterioration after 50 cycles of freeze-thaw, or three-day application of rock salt (wet).
 4. Allowable tolerance shall be plus or minus 1/16 in. any direction.
- N. Joint Mortar: Dry set mortar for header courses shall conform to ASTM C 270, Type M.
- O. Edging – Edge Restraints: Use approved edge restraints where pavement or concrete does not abut the pavers.
- P. Water: Water shall be potable and shall be free of injurious contaminants.
- Q. Catalog cuts and information on the curb supplier shall be submitted to the Engineer for approval prior to ordering the material.

2.2 MIX DESIGN AND TESTING

- A. Concrete mix design and testing shall comply with requirements of applicable Division 03 30 00 – Concrete.
- B. Design mix to produce normal weight concrete consisting of Portland cement, aggregate, water-reducing admixture, air-entraining admixture, and water to produce the following properties:
1. Compressive Strength: 4,000 psi, minimum at 28 days, unless otherwise indicated on the Drawings.
 2. Slump Range: 3"-5" for normal concrete at time of placement
 3. Air Entrainment: 4% to 6%

PART 3 - EXECUTION

3.1 PREPARATION FOR SIDEWALKS

- A. Prepare subgrade to receive sidewalk subbase gravel in accordance with Section 32 11 00.

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- B. Place and compact subbase and base gravel in accordance with Section 31 20 00 and 32 11 00 of these specifications.
- C. Proof-roll prepared base material surface to check for unstable areas. The paving work shall begin after the unsuitable areas have been corrected and are ready to receive paving. Compaction testing for the base material shall be completed prior to the placement of the paving.
- D. Surface Preparation: Remove loose material from compacted base material surface immediately before placing concrete.

3.2 INSTALLATION OF CONCRETE SIDEWALKS

A. Form Construction:

- 1. Set forms to required grades and lines, rigidly braced and secured.
- 2. Install sufficient quantity of forms to allow continuance of work and so that forms remain in place a minimum of 24 hours after concrete placement.
- 3. Check completed formwork for grade and alignment to following tolerances:
 - Top of forms not more than 1/8" in 10'-0".
 - Vertical face on longitudinal axis, not more than 1/4" in 10'-0".
- 4. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

B. Reinforcement: Locate, place and support reinforcement per Division 3 specifications.

C. Concrete Placement:

- 1. Comply with requirements of Division 03 30 00 – Concrete.
- 2. Do not place concrete until base material and forms have been checked for line and grade. Moisten base material if required to provide uniform dampened condition at time concrete is placed. Concrete shall not be placed around manholes or other structure until they are at the required finish elevation and alignment.
- 3. Place concrete using methods which prevent segregation of mix. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Consolidate with care to prevent dislocation of reinforcing, dowels and joint devices.
- 4. Deposit and spread concrete in continuous operation between transverse joints, as far as possible. If interrupted for more than 1/2 hours, place construction joint.

D. Joint Construction:

- 1. Contraction Joints: If joints are specified, the curb, gutter, or sidewalk shall be constructed in uniform sections of the length specified on the plans. If no length is called out on the drawings the distance shall not exceed 6'-0". The joints between sections shall be formed either by steel templates 1/8 inch in thickness, or a length equal to the width of the gutter or curb, and with a depth which will penetrate at least 2 inches below the surface of the

curb and gutter; or with 3/4 inch thick preformed expansion joint filler cut to the exact cross section of the curb or gutter; or by sawing to a depth of at least 2 inches while the concrete is between 4 to 24 hours old. If steel templates are used, they shall be left in place until the concrete has set sufficiently to hold its shape, but shall be removed while the forms are still in place.

2. Longitudinal Construction Joints: Concrete curb, concrete gutter, combination concrete curb and gutter, and sidewalls where specified on the plans, shall be tied to concrete pavement with 1/2 inch round, reinforcement bars of the length and spacing shown on the plans.
 3. Transverse Expansion Joints: Transverse expansion joint in curb, curb and gutter, gutter or sidewalk shall have the filler cut to the exact cross section of the curb, curb and gutter, gutter or sidewalk. The joints shall be similar to the type of expansion joint used in the adjacent pavement.
- E. Joint Fillers: Extend joint fillers full-width and depth of joint, and not less than 1/2" or more than 1" below finished surface where joint sealer is indicated. If not joint sealer, place top of joint filler flush with finished concrete surface. Furnish joint fillers in one-piece lengths for full width being placed, wherever possible. Where more than one length is required, lace or clip joint filler section together.
- F. Joint Sealants: Exterior pavement joint sealants shall be installed per manufacturer's recommendations.
- G. Cold Weather Placing:
1. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions or low temperatures, in compliance with ACI 306 and as specified herein. All expenses associated with the protective measures, temporary heating, etc. shall be at the expense of the Contractor.

When air temperature has fallen to or is expected to fall below 40° F (4° C) uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50° F (10° C) and not more than 80° F (27° C) at point of placement.

Do not use frozen materials or materials containing ice or snow. Do not place concrete or frozen subgrade or subgrade containing frozen materials.

Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical agents, unless otherwise accepted in mix design.

H. Concrete Finishing:

1. After striking off and consolidating concrete, smooth surface by screening and floating. Adjust floating to compact surface and produce uniform texture. After floating, test surface for trueness with 10'-0" straightedge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide continuous smooth finish.
2. Work edges of slabs, gutters, back top edge of curb, and formed joints with an edging tool, and round to 1/2" radius. Eliminate tool marks on concrete surface. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

- a. Inclined Slab Surfaces: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
 - b. Paving: Provide coarse, nonslip finish by scoring surface with stiff-bristled broom perpendicular to line of traffic.
3. Do not remove forms for 24 hours after concrete has been placed. After form removal, clean ends of joints and point up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed.
 4. Protect and cure finished concrete paving using acceptable moist-curing methods, more particularly described in the "water-curing" section of ACI 308-81.
- I. Cleaning and Adjusting:
1. Sweep concrete pavement and wash free of stains, discolorations, dirt, and other foreign material just prior to final inspection.
 2. Protect concrete from damage until acceptance of work. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials.

3.3 CONCRETE PAVERS

- A. Acceptability of base:
1. Contractor shall examine the aggregate and bituminous base to determine its adequacy to support concrete pavers. Evidence of inadequate base shall be brought to the immediate attention to the Engineer.
 2. Start of work of this Section shall constitute acceptance of the aggregate and bituminous base.
- B. Aggregate Base Course: Aggregate material for base beneath concrete pavers shall be to the depth indicated on the Drawings. Base shall be compacted to 95% of the maximum dry density at optimum moisture content, as determined by ASTM D 1557.
- C. Bituminous Setting Bed:
1. Bituminous setting bed shall be installed over the aggregate base. Control bars $\frac{3}{4}$ inc. deep shall be placed directly over the base. If grades must be adjusted, wood chocks under depth control bars shall be set to proper grade. Set two bars parallel to each other to serve as guides for the striking board. The depth control bars must be set carefully to bring the pavers, when laid, to proper grade.
 2. While still hot (not less than 250°F) some of the bituminous bed material shall be placed between the parallel depth control bars. This bed shall be pulled with the striking board over the control bars several times. After each passage, low porous spots shall be showered with fresh bituminous material to produce a smooth, firm, and even setting bed. As soon as this initial panel is completed, advance the first bar to the next position in readiness for striking the next panel. After the depth control bars and wood chocks have been removed, carefully fill any depressions that remain.

3. The setting bed shall be rolled with a power roller to a nominal depth of $\frac{3}{4}$ in., while still hot. The thickness shall be adjusted so that when the bricks are placed and rolled, the top surface of the pavers will be at the required finished grade.

D. Sand Setting Bed:

1. Sand shall be spread over bituminous base course as a setting bed for pavers. Sand shall be spread and leveled to require slope and grade. Minimum thickness of sand shall be 1 in. after leveling. Bed shall not be compacted until pavers are installed.
2. Surface tolerance shall be within $\frac{1}{4}$ in. of required grade as measured with a 10 ft. straightedge in both the transverse and longitudinal directions.

E. Setting Concrete Pavers:

1. Setting bed shall be protected from damage prior to setting pavers.
2. Setting shall be done by competent workmen under adequate supervision, and in accordance with manufacturer's recommendations. Pavers shall be placed on the setting bed, to true line and plane and in required position. Surface edge of one paver shall be level with the next adjacent pavers so that no voids, rocking motions, or tripping hazards are encountered. Edge to edge arris shall not exceed $\frac{1}{16}$ in.
3. Pavers with chips, cracks, or other structural or aesthetic defects shall not be used.
4. Pavers shall be set true to the required lines and grades in the pattern detailed on the Drawings. Pavers shall be tightly butted. Joints between pavers shall be uniform and shall not exceed $\frac{1}{8}$ in.
5. After a sufficient area of pavers has been installed, joints of pavers shall be filled by sweeping stone dust into the joints. When joints are filled, paver surfaces shall be swept clean of stone dust.
6. Where required, pavers shall be accurately cut with a masonry or concrete saw. Cut edges shall be plumb and straight. Scoring and breaking will not be acceptable.
7. Completed surface shall be compacted by running a medium plate vibrator across the top of the pavers. Additional stone dust material shall be swept in the joints during vibration to completely fill joint space.
8. When joints are filled, paver surfaces shall be swept clean of excess stone dust. Swept surfaces shall then be thoroughly dampened with a low-volume fine spray of water.

F. Joint Treatment:

1. Header Courses: Dry set mortar shall be installed in the joints of header courses.
2. Remainder of Joints: On a dry day, after pavers have been installed, joints of pavers shall be filled by sweeping dry sand into the joints. When joints are filled, paver surfaces shall be swept clean, and hosed down with low-volume fine spray of water.

G. Cleaning of Paved Surface: After completion of concrete pavers, paved areas shall be thoroughly swept clean and surface shall be left unsoiled. Where required, surface shall be cleaned with water or an approved cleaner.

3.4 INSTALLATION OF GRANITE CURB

- A. Granite curbing will be installed and backfilled in accordance with provisions of Paragraph 3.06. If Type 5 sloped curb configuration is used, the curb shall be set on a slope as shown on the plans. All granite curb used to form a radius and any granite curb of any type with stone length of less than 36” shall be backfilled with lean concrete to a level equal to the binder pavement surface in front of the curb and a level equal to 3” below finish grade behind the curb.
- B. Protect the granite curb from damage throughout construction and until substantial completion.

3.5 BITUMINOUS CURB

- A. Bituminous curb shall be installed on the bituminous pavement base course prior to placement of final bituminous pavement wearing course. The curb shall be backfilled with approved materials. That shall be placed in layers not exceeding 8 inches in depth, loose measure and thoroughly tamped.
- B. Bituminous curb shall be seal coated after placement in accordance with MDOT Standard Highway specifications.

3.6 HOT BITUMINOUS CONCRETE SIDEWALKS

- A. Bituminous concrete pavement for sidewalks shall be placed in two lifts to provide the total thickness specified on the drawings.
- B. Compaction shall be by a paver roller having a minimum total weight of 2,000 lb. with a minimum of 65 lbs. per inch of drive roll or by satisfactory vibratory equipment.
- C. Placement and quality control shall comply with Section 32 12 16 of these specifications.

3.7 BRICK SIDEWALK INSTALLATION

- A. Preparation: Provide and compact base gravel where required as surface to place stone dust or bituminous concrete as shown on the detail.
- B. Stone Dust: A layer of sand cement base material one (1”) inch thick shall be spread upon the properly prepared bituminous concrete base. This course of stone dust shall be firm but not compacted.
- C. Brick Placement: Perform all masonry work with skilled workmen under adequate supervision. A journeyman brick mason shall supervise all brick placement. Lay all masonry true to lines and grade with all surfaces true, and corners straight and plumb. Lay exposed-to-view bricks smooth side up, with an individual unit-to-unit level tolerance not to exceed 1/8-inch and an overall tolerance from the grade not to exceed ¼-inch in 10 feet in any direction. Lay no unit having chipped edges of face, in exposed-to-view locations. Remove any such unit, if installed and replace with a new undamaged unit.

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1. Brick Laying: The brick shall be laid in patterns shown on the drawings. The joints shall be hand tight, leaving only as much space between bricks as occurs naturally from rough surface or slight irregularities. When necessary, the brick shall be cut with a masonry saw. The Owner will require replacement of improperly broken bricks. No struck brick shall be less than two (2') inches in length.
- D. Compaction: After the bricks are carefully laid upon the properly prepared sand cement base, a 2" x 4" board shall be placed upon the bricks and shall be tapped with a hammer until the bricks reach a firm, unyielding bed and present a surface of the proper grade and slope. Any divergence from line and grade is to be corrected by taking up and relaying the bricks. After setting the bricks, a sufficient amount of sand cement shall be spread over the surface and thoroughly swept or raked so as to fill the joints. All surplus sand cement remaining on the brick paved areas after the joints have been properly filled shall be removed by sweeping. Avoid raking out the joints during the removal of excess sand cement.
- E. Moisture: Sufficient moisture shall be applied by sprinkling to permit the sand cement to achieve and set.
- F. After 3 days, the surface of the walk shall be cleaned with a solution of muriotic acid to remove any cement film.

END OF SECTION 321600

SECTION 321723.13 – PAINTED PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS:

- A. Section 31 20 00 Earth Moving
- B. Section 32 11 00 Base Courses
- C. Section 32 12 16 Asphaltic Paving
- D. Construction Drawings

1.2 PROJECT CONDITIONS

- A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs and warning lights as required.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. The paint shall be a non-bleeding, quick-drying, alkyd petroleum base paint suitable for traffic-bearing surfaces and shall meet FS TTP-85E and mixed in accordance with manufacturer's instructions before application.

PART 3 - EXECUTION

3.1 SITE MEETING

- A. A site meeting including the Engineer, General Contractor, Pavement Marking Subcontractor, and the Owner shall be conducted prior to conducting the work. Marking locations, colors for the markup, and dates of application shall be confirmed at this meeting. The Owner reserves the right to alter or modify said locations at this meeting.

3.2 PREPARATION

- A. Sweep and clean surface to eliminate loose material and dust.

- B. Where existing pavement markings are indicated on the drawings to be removed or would interfere with the adhesion of new paint, a motorized device shall be used to remove the markings. The equipment employed shall not damage the existing paving or create a surface hazardous to vehicle or pedestrian traffic. In all areas within public rights-of-way, the method of marking removal shall be approved by governing authority.

3.3 APPLICATION

- A. Apply two (2) applications of paint at manufacturer's recommended rate without the addition of thinner, with a maximum of 125 square feet per gallon. Install during calm (low wind) conditions in order that spray or unintended paint does not affect adjacent areas. Where necessary, apply during periods of the day when traffic can be controlled and barricaded from area where markings are being installed. Use proper barricades, traffic and safety officers. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use a straightedge to ensure a uniform, clean, and straight stripe. A minimum of 48 hours shall elapse between the applications.
- B. The following items are to be painted with the colors noted below:
 - Pedestrian Crosswalks: White
 - Lane Striping where separating traffic in opposite directions: Yellow
 - Lane Striping where separating traffic in same direction: White
 - Handicap Symbols: White symbol with 4' square non-skid blue background or per Local Code and conforming to ADA requirements.
 - Parking Stall Striping: Yellow
 - Parking space numbering (if required by plans): White
 - Stop Bars: White
 - Directional Arrows: White
 - Fire Lane: Per Fire Department selection
 - Chevrons: Yellow

These colors shall be confirmed with the Owner or Owner's Representative before application.

END OF SECTION 321723.13

SECTION 323000 – SITE IMPROVEMENTS

PART 1 - GENERAL

1.1 GENERAL PROVISIONS

- A. The CONDITIONS OF THE CONTRACT and all Sections of Division 1 are hereby made a part of this Section.

1.2 DESCRIPTION OF WORK

- A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, and without limiting the generality thereof furnish and install the following:

1. Benches
2. Flagpole
3. Bicycle Racks
4. Basketball Goals
5. Combination Soccer/Football Goals (Aluminum)
6. Wood Chip Play Surface
7. Latex Coating for Hard Play Area
8. Playground Equipment (Refer to Specification Section 116800)
9. Timber Edging
10. Light Base Coating

- B. Related Work Specified Elsewhere: Certain work may be part of Bid Alternates. Carefully examine all Contract Documents for requirements which affect the work of this Section. Other Specification Sections which directly relate to work of this Section include, but are not limited to following:

1. Granular fill setting base and backfill material: Section 312200 - Earthwork.
2. Excavation and backfill: Section 312200- Earthwork.

- C. Alternates: Refer to Section 012100 and Section 012300, to determine extent, if any, to which work of this Section will be affected by any Allowances or Alternates, if accepted.

1.3 QUALITY ASSURANCE; SUBMITTALS:

- A. Quality Assurance: Conform to requirements of Section 01 33 00 – Submittals Procedures.

- B. Submittals: Provide as follows:

1. Product Data:
 - a. All manufactured equipment.
 - b. Metal fasteners, anchors, other accessories.

2. Shop Drawings: All items where installation methods are not fully described in product data.

1.4 REFERENCE STANDARDS:

- A. MDOT: Where specified, comply with applicable provision of State of Maine Department of Transportation Standard Specifications for Highways and Bridges, hereinafter referred to as MDOT.
- B. Earthwork: Conform to requirements of Section 312000 – Earth Moving

PART 2 - PRODUCTS

2.1 BASIC MATERIALS:

- A. Reinforcement: ASTM A 615, Grade 60, deformed, hot-dipped galvanized.
 1. Provide minimum reinforcement ration of 3 percent.
- B. Galvanizing: Hot-dipped galvanized after fabrication, conforming to:
 1. ASTM A 386 for assembled products.
 2. ASTM A 153 for iron and steel hardware.

2.2 BASIC INSTALLATION REQUIREMENTS:

- A. Install all materials and equipment in compliance with manufacturer's recommendations, and as indicated on Drawings.
- B. Provide concrete bases and supports as indicated and required.

2.3 BENCHES:

- A. Project benches are to be constructed on granite steps or slabs salvaged from the existing building during demolition.

2.4 FLAGPOLE:

- A. Provide as indicated, conforming to requirements for commercial construction.
 1. Provide a Fiberglass Reinforced Plastic (FRP) Internal Halyard Flagpole Model # PLP 40-I as manufactured by PLP Composite Technologies, Inc., Fiizwilliam, NH 03447 or approved equal.

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- a. Flagpole shall have an overall length of 43 feet, with an exposed height of 39 feet. The butt diameter shall be 7” and the top diameter 3”.
- b. The flagpole shall be equipped with PLP standard fittings including the following:
 - 1) 8” Gold colored aluminum ball
 - 2) Complete with standard fittings and equipment, base, and supports.
 - 3) A single sheave internal fiberglass stationary truck with s/s securing sleeves.
 - 4) #10 polyester halyard.
 - 5) Polyester wire core retaining ring.
 - 6) Vinyl covered counterweight.
 - 7) Stainless steel and nylon internal cam cleat.
 - 8) Handhole door with cylinder cam lock.
 - 9) Brass swivel snaps with vinyl covers.
 - 10) 16” fiberglass flash collar.
 - 11) 8” x 4’-0” fiberglass ground sleeve.
- c. Color tbd by Owner from standard available colors.

2.5 BICYCLE RACK:

- A. Provide as indicated, conforming to requirements for commercial construction.
 1. Manufacture and Model: GameTime 7700 Loop Bike Rack or approved equal.
 2. Length of rack: 7’0” minimum.
 3. Height of rack: Approximately 59-1/2 inches with 24 inches in below grade foundations.
 4. Weight of rack: Approximately 100 pounds.
 5. Mounting system: Installed in 12 inch diameter concrete foundations as shown on the details.
 6. Coating: Powder coated finish.
 7. Color selection: By Owner. Selection made during the submittal/review process.

2.6 BASKETBALL GOAL STANDARDS

- A. Basketball Goal Standards shall be:
 1. Post and Adjustable Extension manufactured by GameTime, PO Box 121, Fort Payne, Alabama 35967, Part No. 503 or approved equal.
 2. Cast Aluminum Fan Shaped Backboard manufactured by GameTime, PO Box 121, Fort Payne, Alabama 35967, Part No. 854 or approved equal.
 3. Heavy Duty Flex Goal w/Nylon Net manufactured GameTime, PO Box 121, Fort Payne, Alabama 35967, Part No. 874 or approved equal.
 4. Goal Post Safety Padding manufactured by Bison Inc., 603 “L” Street, Lincoln, Nebraska 68508, Part No. BA700PP or approved equal.
- B. Provide a poured concrete base for each basketball goal as per drawings.

2.7 COMBINATION SOCCER/FOOTBALL GOALS (ALUMINUM)

- A. Base: Shall be Model #SE720 as manufactured by: SportsEdge P.O. Box 837 Troutman, NC 28166 or approved equal Telephone: 800-334-6057, Fax: 704-528-0179, Email: info@sportsedge.com
- B. COMPONENTS:
Model #SE720 combination football / soccer goal shall be manufactured of all aluminum construction and have a white powder coated finish. Goal posts should meet the following criteria as a minimum.
 - 1. 8' H x 24' W NFSHSA regulation size soccer goal, 10' H x 23'-4" W NFSHSA regulation football goal.
 - 2. 4" W x 2" D front posts & crossbar. Detachable 1.75" O.D. football uprights and soccer backstays.
 - 3. Powder coated white finish with safe, smooth radius corners.
 - 4. Includes: 3.0mm Soccer Net (Orange, Blue, Yellow or Red).
 - 5. Installation Hardware consisting of the following:
 - a. Steel ground sleeves
 - b. Assembly hardware
- C. Installation of Equipment: All athletic equipment shall be installed as recommended by manufacturer, and as indicated on the drawings.

2.8 WOOD CHIP PLAY SURFACE

- A. Soft Play area shall consist of clean hardwood chips manufactured for playground use and meeting ASTM requirements for ADA accessibility, as manufactured by Jolly Gardener Products, Inc, PO Box 527, Poland ME 04274 or approved equal.
- B. Edging for soft play areas shall be "Trex" recycled plastic timber edging or approved equal. Size of timbers shall be 2" x 6" nominal. Color to be determined from standard colors available. Edging shall be anchored in place with metal stakes driven a minimum of 5'-6" into the ground 4'-0" on center.

2.9 LATEX COATING FOR HARD PLAY AREA

- A. The system shall be comprised of two "filler coats" and one "surface coat".
 - 1. The filler coats should contain sufficient solids to completely fill the voids of the pavement prior to application of the surface coat, and if desired may have materials added as per manufacturer's instructions.
 - 2. Each layer shall be of the same brand and color.
- B. Manufacturers: California Products Corp., Andover, MA. 01810 / Plexipave System www.plexipave.com or approved equal.

Substitutions: Submit requests at least 7 days prior to the bid date with a complete type written list of proposed substitutions with sufficient data, drawings, samples and literature to demonstrate to the owner's satisfaction that the proposed substitution is of equal quality and utility to the specified product. Information must include a QUV test of at least 1000 hours illustrating the UV stability of the system. The system shall have an ITF pace rating in Category 2. Under no

circumstance may the final color surface contain silica sand added at the job site.

C. Materials (General)

1. Patching Mix (California Court Patch Binder) - for use in patching cracks, holes, depressions and other surface imperfections.
2. Crack Filler (Plexipave Crack Filler) - for use in filling fine cracks.
3. Acrylic Filler Course (California Acrylic Resurfacer) – for use as a filler for new or existing asphalt surfaces. The 100% acrylic filler shall be blended with approved silica sand at the job site.
4. Acrylic Color Playing Surface (Plexichrome/Plexipave Color Base) – for use as the finish color and texture. Plexichrome and Plexipave Color Base are blended at the job site to achieve the correct surface texture. *Factory Fortified Plexipave may be used as an alternative material.
5. Line Paint (California Line Paint) – for use as the line marking on the court/play surface.
6. Water – for use in dilution/mixing shall be clean and potable.

D. Material Specifications

1. Court Patch Binder – 100% acrylic resin blended with Portland Cement and silica sand.
 - a. Percent solids by weight (minimum) 46%
 - b. Weight 8.7-8.9 lbs./gallon
2. Plexipave Crack Filler – 100% acrylic resin heavily filled with sand.
 - a. Percent solids by weight (minimum) 85%
 - b. Percent solids by weight (minimum) 15 lbs./gallon
3. California Acrylic Resurfacer – 100% acrylic resin (no vinyl copolymerization constituent). The product shall contain not less than 3.5% attapulgite.
 - a. Percent solids by weight (minimum) 26.7%
 - b. Weight 8.7-8.9 lbs./gallon
4. Plexichrome – 100% acrylic resin (no vinyl copolymerization constituent) with selected light fast pigments. Green shall contain not less than 8% chrome oxide.
 - a. Percent solids by weight (minimum) 36.5%
 - b. Weight 10.0-10.2 lbs./gallon
5. Plexipave Color Base – 100% acrylic resin containing no vinyl copolymerization constituent. Contains not more than 63% rounded silica sand.
 - a. Percent solids by weight (minimum) 74%

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b. Weight 13.1-14.1 lbs./gallon

6. California Line Paint – 100% acrylic resin containing no alkyds or vinyl constituents. Texturing shall be rounded silica sand.

a. Percent solids by weight (minimum) 60.5%

b. Weight 12-12.3 lbs./gallon

All surfacing materials shall be non-flammable and have a VOC content of not less than 100g./ltr. Measured by EPA method 24.

Local sands are not acceptable in the color playing surface. Sands must be incorporated at the manufacturing location to insure quality and stability.

2.10 PLAYGROUND EQUIPMENT (REFER TO SPECIFICATION SECTION 116800)

2.11 TIMBER EDGING

A. Timber edging material shall have been treated with a water-borne preservative rated safe for playground equipment as defined by the American Wood Preserver's Association (AWPA) standards.

2.12 LIGHT BASE COATING

A. An acrylic latex coating shall be applied to the light pole bases. Two applications are required.

PART 3 – EXECUTION

3.1 GENERAL

A. Install all materials and equipment in compliance with manufacturer's recommendations, and as indicated on Drawings.

B. Provide concrete bases, supports or slabs as indicated and required.

3.2 INSTALLATION OF BENCHES

A. The granite benches shall be supported at 3 locations using old granite curb and or broken granite salvaged during demolition

B. Prepare a base of 12 inches of base gravel with a surface 6 inches below finish grade.

C. Install bench supports 6 inches from the edge and in the center of each bench

D. Set pads to an elevation that will allow the bench to be nearly level

E. Set the bench slab onto the supports and shim to be level

- F. Use a non-shrink grout to fill all voids between the supports and underside of the slab

3.3 INSTALLATION OF FLAGPOLE

- A. Install flagpole in location shown on Drawings and per manufacturer's specifications.
- B. Protect installed flagpole during construction phase by appropriate measures until acceptance of project by Owner.

3.4 INSTALLATION OF WOOD CHIP PLAY SURFACE

- A. Install only after the timber edging and all underlying infiltration, base gravel, fabrics, and playground equipment has been installed.
- B. Install in uniform 4 inch lifts and rake level

3.5 INSTALLATION OF LATEX COATING FOR HARD SURFACE PLAYGROUND

3.5.1 WEATHER LIMITATIONS:

- A. Do not install when rainfall is imminent or extremely high humidity prevents drying.
- B. Do not apply unless surface and air temperature are 50°F and rising.
- C. Do not apply if surface temperature is in excess of 140°F.

3.5.2 PREPARATION FOR ACRYLIC COLOR PLAYING SYSTEM:

- A. Clean surfaces of loose dirt, oil, grease, leaves, and other debris in strict accordance with manufacturer's directions. Pressure washing will be necessary to adequately clean areas to be coated. Any areas previously showing algae growth shall be treated with Clorox or approved product to kill the organisms and then be properly rinsed.
- B. Holes and cracks: Cracks and holes shall be cleaned and a suitable soil sterilant, as approved by the owner, shall be applied to kill all vegetation 14 days prior to use of **Court Patch Binder** according to manufacturer's specifications.
- C. Depression: Depressions holding enough water to cover a five cent piece shall be filled with Court Patch Binder Patching Mix. 3 gallons of Court Patch Binder, 100 lbs. 60-80 silica sand, 1 gallon Dry Portland Cement (Type I). **This step shall be accomplished prior to the squeegee application of Acrylic Resurfacer.** The contractor shall flood all the courts and then allow draining. Define and mark all areas holding enough water to cover a nickel. After defined areas are dry, prime with tack coat mixture of 2 parts water/1 part Court Patch Binder. Allow tack coat to dry completely. Spread Court Patch Binder mix true to grade using a straight edge (never a squeegee) for strike off. Steel trowel or wood float the patch so that the texture matches the surrounding area. Never add water to mix. Light misting on surface and edges to feather in is allowed as needed to maintain work ability. Allow to dry thoroughly and cure.

NO WORK FROM THIS STAGE ON SHALL COMMENCE UNTIL AN INSPECTOR HAS ACCEPTED THE SURFACE.

D. Filler Course. (Acrylic Resurfacer): Filler course shall be applied to the clean underlying surface in one application to obtain a total quantity of not less than .06 gallon per square yard based on the material prior to any dilution. Acrylic Resurfacer may be used to pre-coat depression and crack/hole repairs to achieve better planarity prior to filler course application.

1. Over a properly repaired surface of asphalt on existing courts, apply one coat of Acrylic Resurfacer according to the following mix:

Acrylic Resurfacer	55 gallons
Water	20 - 40 gallons
Sand	600-800 pounds / 60-80 mesh
Liquid Yield	112-138 gallons

On new asphalt, two coats of Acrylic Resurfacer shall be used to properly fill all voids in the asphalt surface. Use clean, dry 50-60 mesh sand and clean, potable water to make mixes. The quantity of sand and water in the above mix may be adjusted within above limits to complement the roughness and temperature of the surface.

2. Mix the ingredients thoroughly using accepted mixing devices and use a 70 Durometer rubber bladed squeegee to apply each coat of Acrylic Resurfacer as required.
3. Allow the application of Acrylic Resurfacer to dry thoroughly. Scrape off all ridges and rough spots prior to any subsequent application of Acrylic Resurfacer or subsequent cushion or color surface system.

3.5.3 APPLICATION OF ACRYLIC COLOR PLAYING SURFACE

A. All areas to be color coated shall be clean, free from sand, clay, grease, dust, salt or other foreign matters. The Contractor shall obtain the Engineer's approval, prior to applying any surface treatment.

B. Blend color base and Plexichrome with a mechanical mixer to achieve a uniform Fortified Plexipave mixture. The mix shall be:

Color Base	30 gallons
Plexichrome	20 gallons
Water	20 gallons

C. Application shall be made by 50 durometer rubber faced squeegees. The Fortified Plexipave mixture should be poured on to the court surface and spread to a uniform thickness in a regular pattern.

D. A total of 3 applications of Fortified Plexipave shall be made to achieve a total application rate of not less than .15 gal./sy. No application should be made until the previous application is thoroughly dry.

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3.5.4 LINE PAINTING

- A. Line shall be 2” wide unless otherwise noted on the drawings. Lines shall be carefully laid out in accordance with ASBA and USTA guidelines. The area to be marked shall be taped to insure a crisp line. The California Line Paint shall have a texture similar to the surrounding play surface. Application shall be made by brush or roller at the rate of 150-200 sg./gal. (3/4 gal. per tennis court).

3.5.5 PROTECTION

- A. Erect temporary barriers to protect coatings during drying and curing.
- B. Lock gates to prevent use until acceptance by the owner’s representative.

3.5.6 CLEAN UP

- A. Remove all containers, surplus materials and debris. Dispose of materials in accordance with local, state and Federal regulations.
- B. Leave site in a clean and orderly condition.

3.6 INSTALLATION OF LIGHT BASE COATING

- A. Install acrylic coatings only when conditions meet the recommendations of the coating supplier
- B. Make sure all surfaces are clean, dry, and free of debris
- C. Install first coating before the foundation is installed in the excavation
- D. Install second coating before the light pole is erected
- E. Touch up after light pole has been erected.

PART 4 – WARRANTIES

4.1 GENERAL

- A. The supplier shall provide warranties on all materials and workmanship for one year excluding vandalism.
- B. Contractor shall guarantee bases for one year excluding vandalism.

END OF SECTION 323000

SECTION 323113 – CHAIN LINK FENCE AND GATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Provide chain link fence including erection accessories, fittings, and fastenings as indicated on Drawings.
2. Adhere vinyl coated fence as specified. All fabric, post, and hardware shall be vinyl coated with no visible non-coated materials upon completion of the fence.

B. Related Items:

1. Construction Drawings - Site Plans.
2. Manufacturer's technical data and installation requirements.

1.2 REFERENCE

- A. ANSI/ASTM A123 - Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
- B. ANSI/ASTM F567 - Installation of Chain-Link Fence.
- C. ASTM A116 - Zinc-Coated (Galvanized) Steel Woven Wire Fence Fabric.
- D. ASTM A120 - Pipe, Steel, Black and Hot-Dipped Zinc Coated (Galvanized) Welded and seamless, for Ordinary Uses.
- E. ASTM A121 - Zinc-Coated (Galvanized) Steel Barbed Wire.
- F. ASTM A153 - Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- G. ASTM A392 - Zinc-Coated Steel Chain-Link Fence Fabric.
- H. ASTM A428 - Weight of Coating on Aluminum-Coated Iron or Steel Articles.
- I. ASTM A491 - Aluminum-Coated Steel Chain Link Fence Fabric.
- J. ASTM C569 - Steel, Carbon (0.15) Maximum Percent), Hot-Rolled Sheet and Strip Commercial Quality.
- K. ASTM C585 - Aluminum Coated Steel Barbed Wire.
- L. ASTM C94 - Ready Mixed Concrete.

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- M. ASTM F573 - Residential Zinc-Coated Steel Chain Link Fence Fabric.
- N. ASTM F668 – Poly (Vinyl Chloride) (PVC) Coated Steel Chain Link Fence Fabric.
- O. Chain Link Fence Manufacturers Institute (CLFMI) - Product Manual.
- P. FS RR-F-191 - Fencing, Wire and Post Metal (and Gates, Chain Link Fence Fabric, and Accessories).

1.3 SUBMITTALS

- A. Accurately record actual locations of property perimeter posts relative to property lines and easements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:
 - 1. Allied Tube and Conduit Corporation
 - 2. Anchor Fence, Inc.
 - 3. United States Steel

2.2 MATERIALS

- A. Fabric
 - 1. No. 9 ga. (0.148" +0.005") finished size galvanized steel wires, 2" mesh, with both top and bottom salvages twisted and knuckled finish. Provide vinyl coating where noted on the drawings.
 - 2. Furnish one-piece fabric widths for fencing.
- B. End, Corner, and Pull Posts: Galvanized steel, minimum sizes and weights as follows:
 - 1. Up to 6'-0" Fabric Height: 2.375" O.D. pipe, 3.65 lbs./lin. ft., or 3.5"x3.5" roll-formed sections, 4.85 lbs./lin. ft.
 - 2. Over 6'-0" Fabric Height: 2.875" O.D. pipe, 5.79 lbs./lin. ft.
 - 3. Provide vinyl coating where noted on drawings.

- C. Line Posts: Galvanized steel, minimum sizes and weights as follows:
1. Up to 6'-0" Fabric Height: 1.90" O.D. steel pipe, 2.70 lbs./lin. ft. or 1.875" x 1.625" C-sections, 2.28 lbs./lin. ft.
 2. 6'-0" to 8'-0" Fabric Height: 2.375" O.D. steel pipe, 3.65 lbs./lin. ft. or 2.25" x 1.875" H-sections, 2.64 lbs./lin. ft.
 3. Over 8'-0" Fabric Height: 2.875" O.D. steel pipe, 5.79 lbs./lin. ft. or 2.25"x1.875" H-sections, 3.26 lbs./lin. ft.
 4. Provide vinyl coating where noted on drawings.
- D. Gate Posts: Galvanized steel posts for supporting single gate leaf or one leaf of double gate installation for nominal gate widths as follows:
1. Up to 6'-0": 3.5" x 3.5" roll-formed section, 4.85 lbs/lin.ft. or 2.875" O.D. pipe, 5.79 lbs/lin.ft.
 2. Over 6'-0" to 13'-0": 4.00" O.D. pipe, 9.11 lbs/lin.ft.
 3. Provide vinyl coating where noted on drawings.
- E. Top Rail: Rails: 1.66" OD pipe, 2.27 lbs./ft. or 1.625" x 1.25" roll-formed sections, 1.35 lbs/ft.; galvanized steel, manufacturer's longest lengths.
- F. Couplings: Expansion type, approximately 6" long, for each joint.
- G. Attaching Devices: Provide means for attaching top rail securely to each gate corner, pull and end post.
- H. Sleeves: Galvanized steel pipe not less than 6" long and with inside diameter not less than 1/2" greater than outside diameter of pipe. Provide steel plate closure welded to bottom of sleeve of width and length not less than 1" greater than outside diameter of sleeve. Provide vinyl coating where noted on drawings.
- I. Tension Wire: 7 gauge galvanized steel, coated coil spring wire, located at bottom of fabric. Provide vinyl coating where noted on drawings.
- J. Wire Ties: 11 ga. galvanized steel. Provide vinyl coating where noted on drawings.
- K. Post Brace Assembly: Manufacturer's standard adjustable brace at end and gate posts and at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric. Use same material as top rail for brace, and truss to line posts with 0.375" diameter rod and adjustable tightener. Provide vinyl coating where noted on drawings.
- L. Post Tops: Galvanized steel with weathertight closure cap for each tubular post. Furnish caps with openings to permit passage of top rail. Provide vinyl coating where noted on drawings.

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- M. Stretcher Bars: Galvanized steel, one piece lengths equal to full height of fabric, with minimum cross-section of 3/16"x3/4". Provide one stretch bar for each gate and end post, and two for each corner and pull post. Provide vinyl coating where noted on drawings.
- N. Stretch Bar Bands: Manufacturer's standard. Provide vinyl coating where noted on drawings.
- O. Gate Cross-bracing: 3/8" diameter galvanized steel adjustable length truss rods. Provide vinyl coating where noted on drawings.
- P. Portland Cement: ASTM C 150.
- Q. Aggregates: ASTM C 33.
- R. Water: Clean.
- S. Non-shrink non-Metallic Grout: Premixed, factory-packaged, noncorrosive nonstaining, nongaseous, exterior grout complying with CE CRD-C621.
- T. Swinging Gate Hardware:
 - 1. Hinges: Size and material to suit gate size, non-lift-off type, offset to permit 180 degree gate opening. Provide 1-1/2" pair of hinges for each leaf over 6'-0" nominal height.
 - 2. Latch: Forked type of plunger-bar type to permit operation from either side of gate, with padlock eye as integral part of latch.
- U. Double Gates Hardware: Provide gate stops for double gates, consisting of mushroom type of flush plate with anchors set in concrete, to engage center drop rod or plunger bar. Include locking device and padlock eye as integral part of latch, using one padlock for locking both gate leaves. Provide vinyl coating where noted on drawings.
- V. Sliding Gate Hardware: Provide manufacturer's standard heavy-duty track, ball-bearing hanger sheaves, overhead framing and supports, guides, stays, bracing, and accessories as required.
- W. Fence Slat Inserts:
 - 1. Materials: The slat insert is to be extruded from High Density Polyethylene (HDPE), color pigments and ultra violet (UV) inhibitors, specifically designed to return the harmful effects of the sun and lengthen the life of the product. The material shall include Ethyl Vinyl Acetate (EVA), a softer plastic to keep the wings flexible and resilient.
 - 2. Durability: The fence products shall be resistant to: severe weather conditions, salt, water, sand, road dirt, most acids, alcohol, alkaline, ammonia, petroleum distillates, and common environmental pollutants.
 - 3. Maintenance: The material shall be suitable for pressure cleaning of surface contaminants with plain water.
 - 4. Limited Warranty: A 25-year, pro-rata warranty against breakage under normal conditions shall be provided by the vendor.

PART 3 - EXECUTION

3.1 GATE FABRICATION

- A. Fabricate swing gate perimeter frames of 1.90" O.D. pipe, galvanized steel. Provide vinyl coating where noted on drawings. Provide horizontal and vertical members to ensure proper gate operation and for attachment of fabric, hardware, and accessories. Space frame members a maximum of 8'-0" apart.
- B. Assemble gate frames by welding or special fittings and rivets, for rigid connections. Install same fabric as for fence with stretcher bars at vertical edges. Install diagonal cross-bracing on gates as required to ensure rigid frame without sag or twist. Bars may be used at top and bottom edges. Attach stretchers to gate frame at 15" o.c. maximum.
- C. Attach hardware to provide security against removal or breakage.

3.2 FINISH

- A. Fabric Finish: Galvanized, ASTM A 392, Class I, with not less than 1.2 oz. zinc/sq. ft. of surface. Except where vinyl coating is noted.
- B. Framing: Galvanized steel, ASTM A 120 or A 123, with not less than 1.8 oz. zinc/sq. ft. of surface. Except where vinyl coating is noted.
- C. Hardware and Accessories: Galvanized, ASTM A 153 with zinc weights in accordance with Table I of ASTM A 153. Except where vinyl coating is noted.

3.3 CONCRETE MIXING

- A. Mix materials to obtain concrete with minimum 28-day compressive strength of 2,500 psi; 1" maximum size aggregate, maximum 3" slump, and 2 - 4% entrained air.

3.4 INSTALLATION

- A. Comply with recommended procedures and instructions of fencing manufacturer. Provide secure, aligned installation with line posts spaced at 10'-0" o.c. maximum.
- B. Grade Set Posts: Drill or hand excavate using post hole digger in firm undisturbed or compacted soil.
- C. Excavate hole for each post to minimum diameter recommended by fence manufacturer but not less than four times largest cross-section of post. Excavate hole depths approximately 3" lower than post bottom with bottom of posts set not less than 36" below finish grade surface.
- D. Center and align posts in holes 3" above bottom of excavation.

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- E. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Extend concrete footing 2" above grade and trowel to crown to shed water.
- F. Sleeve Set Posts: Anchor posts by means of pipe sleeves preset and anchored into concrete. After posts have been inserted into sleeves, fill annular space between post and sleeve solid with nonshrink, non-metallic grout, mixed and placed to comply with grout manufacturer's directions.
- G. Top Rails: Run rail continuously, bending to form radius for curved runs. Provide expansion couplings as recommended by manufacturer.
- H. Center Rails: Provide center rails where indicated. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.
- I. Brace Assemblies: Install brace so posts are plumb when diagonal rod is under proper tension.
- J. Tension Wire: Install tension wires through post cap loops before stretching fabric and tie to each post cap with not less than 6 ga. galvanized wire. Fasten fabric to tension wire using 11 ga. galvanized steel hog rings spaced 24" o.c.
- K. Fabric: Leave approximately 1" between finish grade and bottom salvage. Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, and anchor to framework so that fabric remains in tension after pulling force is released.
- L. Stretcher Bars: Secure at end, corner, pull, and gate posts by threading through or clamping to fabric at 4" o.c., and secure to posts with metal bands spaced at 15" o.c.
- M. Tie Wires
 - 1. Use U-shaped wire, conforming with diameter of pipe to which attached, clasping pipe and fabric firmly when ends twisted at least two full turns. Bend ends of wire to minimize hazard to persons or clothing.
 - 2. Tie fabric to line posts with wire ties spaced 12" o.c. Tie fabric to rails and braces with wire ties spaced 24" o.c. Tie fabric to tension wires with hog rings spaced 24" o.c.
 - 3. Manufacturer's standard procedure will be accepted if of equal strength and durability.
- N. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts.
- O. Gates: Install gates plumb, level, and secure for full opening without interference. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubrication.
- P. Ground Surfaces: Except where noted otherwise on the contract drawings, the fence shall be centered on a 3'-0" weed control fabric with 4" of approved black mulch.

END OF SECTION 323113

SECTION 324000 – SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Provide traffic control signs complying with U.S. Department of Transportation, Federal Highway Administration's "Manual on Uniform on Traffic Control Devices", local codes, and as specified. See Drawings for type, location, and quantity of signs required.
- B. Related Sections:
 - 1. Construction Drawings.
 - 2. Manufacturer's Mounting Instructions.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- A. Signs to meet FHWA requirements NCHRP 350 certification, engineer grade reflective.
- B. Provide information for all signs, proposed mounting heights, mounting hardware, and posts to be submitted to the Owner for review and approval prior to installation.
- C. Posts to be Square Tube Products Nex Sign Post System.

2.2 MATERIALS

- 1. To be backed with Alucobond panels, to be tan or light grey or selected by the Owner. To be painted with reflective baked-enamel finish with following colors:
- 2. "STOP" Signs: (R1-1) 24"x24", Octagon, reflectorized copy and border.
- 3. "SPEED LIMIT" Signs: (R2-1) 18"x24", black legend on white background.
- 4. "HANDICAPPED SYMBOL" Signs: (R7-Series) per size shown on the contract drawing, white legend on blue background. Handicapped van accessible sign shall be the dimensions shown on the contract drawings.
- 5. "NO PARKING, FIRE LANE" Signs: (R7-Series) 12"x18", red letters on white background.
- 6. "KEEP RIGHT" signs: (R4-7a) 18"x24", black letters and symbol on white background.

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7. "DO NOT ENTER" Signs: (R5-1) Highway Dept. standard red and white sign except 24"x24" size.
8. Miscellaneous Signs: Per Manual on Uniform Traffic Control Device recommendations or lettered with dimensions shown on the contract drawings.

2.3 POSTS

- A. Posts shall be everbright powdercoat, square shape, 2-inch, 14 gauge with stainless steel mounting hardware, with colors as shown on the drawings or selected by the Owner.

PART 3 - EXECUTION

- A. Conduct an on-site meeting with the Engineer and Owner prior to start of the work to review/confirm sign location and types.
- B. Red signs shall be on top where multiple signs are on a single post, larger signs shall be installed above smaller signs.
- C. Install weed control collar when signs are installed in turf areas.
- D. All signs in pedestrian areas shall be mounted with the bottom of the sign at 7' above finish grade. Signs in non-pedestrian areas shall be mounted with the bottom of the sign at 5' above finish grade except ADA signs which shall be 7'. Set posts vertical and plumb as shown in the plans. Mount signs in accordance with manufacturer's instructions. Check mounting height, replace any posts which are not installed plumb.

END OF SECTION 324000

SECTION 329200 – TURF AND GRASSES

PART 1 – GENERAL

1.1 WORK INCLUDED

- A. Provide all materials and equipment, and do all work required to complete the loaming, seeding and sodding including furnishings and placing topsoil, as indicated on the Drawings and as specified.

1.2 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 312000, EARTH MOVING, Establishment of subgrade elevation.
 - 2. Section 329300, TREES, PLANTS, AND GROUND COVERS, Landscaping.

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. American Society for Testing and Materials (ASTM)
 - C 136 Sieve Analysis of Fine and Coarse Aggregates
 - E 11 Wire-Cloth Sieves for Testing Purposes

1.4 SUBMITTALS

- A. Samples: The following samples shall be submitted:

<u>Material</u>	<u>Quantity (lb.)</u>
Topsoil	1
Fertilizer	1

- B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following materials if to be used on the project:

Aluminum sulfate
Fertilizer
Lime

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- C. Certificates: Labels from the manufacturer’s container certifying that the product meets the specified requirements shall be submitted for the following materials:

Grass seed mix (each)	Commercial fertilizer
Ground limestone	Seed mix for sod

- D. Gradation and laboratory analysis:

Topsoil without Admixture
Topsoil with Admixtures

1.5 INSPECTION AND TESTING

- A. Work will be subject to inspection at all times by the Engineer/Landscape Owner. The Owner reserves the right to engage an independent testing laboratory in accordance with the requirements of Section 01 45 00 QUALITY CONTROL, to analyze and test materials used in the construction of the work. Where directed by the Engineer/Landscape Owner the testing laboratory will make material analyses and will report to the Engineer/Landscape Owner whether material conform to the requirements of this specification.

1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
2. Testing equipment will be provided by and tests performed by the testing laboratory. Upon request by the Engineer/Landscape Owner, the Contractor shall provide such auxiliary personnel and services needed to accomplish the testing work and to repair damage caused thereto by the permanent work.
3. Gradation of granular materials shall be determined in accordance with ASTM C 136. Sieves for determining material gradation shall be as described in ASTM E 11.

- B. Testing, analyses, and inspection required by the Contractor for his own information or guidance shall be at his own expense.

- C. The Contractor shall engage an independent testing agency to perform the following tests and analyses:

<u>Material</u>	<u>Tests and Analysis Required</u>
Topsoil	Mechanical analysis of soil and determination of pH and organic matter content, and nutrient content. Recommendations shall be made by the testing agency as to the type and quantity of soil additives required to bring nutrient content and pH to satisfactory levels for seeding and sodding. Organic admixtures shall be provided and blended to provide an average organic content of 8% with a minimum of any test having 6% organic content by dry weight.

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1. Materials shall not be used in construction until test results have been reviewed by the Engineer/Landscape Owner.
2. All costs associated with testing shall be at the expense of the Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Digging Sod:

1. Sod shall not be dug at the nursery or approved source until ready to transport sod to the site of the work or acceptable storage location.
2. Before stripping, sod shall be mowed at a uniform height of 2 in.
3. Cut sod to specified and to standard width and length desired.

B. Transportation of Sod:

1. Sod transported to the Project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury. Closed vehicles shall be adequately ventilated to prevent overheating of the sod.
2. Evidence of inadequate protection following the digging, carelessness while in transit, or improper handling or storage, shall be cause for rejection.
3. Sod shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the sod is in transit, being handled, or is in temporary storage.
4. Upon arrival at the temporary storage location or the site of the work, sod material shall be inspected for proper shipping procedures. Should the sod be dried out, the Engineer/Landscape Owner will reject the sod. When sod has been rejected, the Contractor shall at once remove it from the area of the work and replace it with acceptable material.
5. Unless otherwise authorized by the Engineer/Landscape Owner, the Contractor shall notify the Engineer/Landscape Owner at least two working days in advance of the anticipated delivery date of sod material. Certificate of Inspection when required shall accompany each shipment.

C. Handling and Storage of Sod:

1. Sod material shall be handled with extreme care to avoid breaking or tearing strips.
2. Sod shall not be stored for longer than 30 hours prior to installation. Sod shall be stored in a compact group and shall be kept moist. Sod shall be prevented from freezing.
3. Sod that has been damaged by poor handling or improper storage will be rejected by the Engineer or Landscape Owner.

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- D. Deliver seed in original sealed containers, labeled with analysis of seed mixture, percentage of pure seed, year of production, net weight, date of packaging, location of packaging, and name of seed grower. Damaged packages will not be accepted.
- E. Deliver fertilizer in sealed waterproof bags, printed with manufacturer's name, weight, and guaranteed analysis.

1.7 PLANTING SEASON

- A. Planting season for seeding shall be as follows:

<u>Item</u>	<u>Planting Period</u>	
	<u>Spring</u>	<u>Fall</u>
Grass Seed Mixes	4/15 to 6/15	8/15 to 10/15

- B. Planting season for sod shall be as follows:

<u>Item</u>	<u>Planting Period</u>	
	<u>Spring</u>	<u>Fall</u>
Sod	4/15 to 7/1	8/15 to 11/1

- C. Planting shall only be performed when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.
- D. Planting season may be extended with the written permission of the Engineer/Landscape Owner.

1.8 ACCEPTANCE

- A. Acceptance:

1. The Engineer/Landscape Owner will inspect all work for Substantial Completion upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date of inspection.
2. Acceptance of material by the Engineer/Landscape Owner will be for general conformance to specified requirements, and shall not relieve the Contractor of responsibility for full conformance to the Contract Documents.
3. Upon completion and re-inspection of all repairs or renewals necessary in the judgment of the Engineer/Landscape Owner, the Engineer/Landscape Owner will recommend to the Owner that the work of this Section be accepted.

- B. Sod and seed areas will be accepted when in compliance with all the following conditions:

1. Roots are thoroughly knit to the soil;
2. Absence of visible joints (sodded areas);

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3. All areas show a uniform stand of specified grass in healthy condition, free of weeds, individual bare spots of over 72 square inches or multiple bare spots in excess of 1 percent of the area.
4. At least 60 days have elapsed since the completion of work under this Section.

PART 2 – PRODUCTS

2.1 SEED

- A. Seed shall be of the previous year’s crop with 0.5% or less weed seed, and 1.75% or less crop seed, by weight. Seed shall be dry and free of mold. Seed shall meet the following requirements.
- B. Seed Mixture:
 1. Standard grade seed of the most recent season’s crop. Seed shall be dry and free of mold.
 2. Seed mixture shall be suitable as follows:

Name of Seed	% by Weight in Mixture	Minimum % Purity	Minimum % Germination
Permanent Seeding – Athletic Field Areas			
Kentucky Bluegrass	35%	95%	85%
Perennial Ryegrass	30%	95%	85%
Penn Lawn Tall Fescue	35%	95%	85%
Temporary Seeding Plan			
Perennial Ryegrass	50%	95%	85%
Annual Ryegrass	50%	95%	85%
Lawn Areas (Park Mix) – Alternate to Permanent Seeding in Athletic Field Areas			
Kentucky Bluegrass	35%	95%	85%
Creeping Red Fescue	20%	95%	85%
Chewings Fescue	15%	95%	85%
Imp. Perennial Ryegrass	15%	95%	85%
Annual Ryegrass	15%	95%	85%
Low Maintenance Areas – Alternate to Seeding – Other Areas			
Tall Fescue	35%	95%	85%
Creeping Red Fescue	30%	95%	85%
Perennial Ryegrass	20%	95%	85%
Annual Ryegrass	15%	95%	85%
Erosion Control Mix – A			
New England Erosion Control/Restoration Seed Mix for Detention Basins and Moist Soil Conditions by New England Wetland Plants, Inc.			
Erosion Control Mix – B			
New England Erosion Control/Restoration Seed Mix for Dry Sites by New England Wetland Plants, Inc.			

2.2 SOD

- A. Sod shall be a triplex mixture of hybrid bluegrass. Mixture shall contain approximately equal portions of each hybrid component. Hybrids shall include Cheri Kentucky Bluegrass, Flying Kentucky Bluegrass, Glade Kentucky Bluegrass, Baron Kentucky Bluegrass, or comparable equal bluegrass hybrids.
- B. Sod shall be nursery grown on cultivated mineral agricultural soils. Sod shall have been mowed regularly and carefully, and otherwise maintained from planting to harvest.
- C. Thickness of Cut: Sod shall be machine cut at a uniform soil thickness of 5/8 in., plus or minus ¼ in., at the time of cutting. Measurement for thickness shall exclude top growth and thatch.
- D. Strip Size: Individual pieces of sod shall be cut to the supplier's standards width and length. Maximum allowable deviation from standard widths and lengths shall be plus or minus ½ in. on width, and plus or minus 5% on length. Broken strips and torn and uneven ends will not be acceptable.
- E. Strength of Sod Strips: Standard size sections of sod shall be strong enough to support their own weight and retain their size and shape if suspended vertically when grasped in the upper 10% of the section.
- F. Moisture Content: Sod shall not be harvested or transplanted when moisture content (excessively dry or wet) may adversely affect its survival.
- G. Time Limitations: Sod shall be harvested, delivered, and transplanted within a 36-hour period unless a suitable preservation method is approved prior to delivery. Sod not transplanted within this period shall be inspected and approved by the Engineer/Landscape Owner prior to its installation.
- H. Thatch: Sod shall be free of diseases, nematodes, and soil-borne insects. State Nursery and Plant Material Laws require that all sod be inspected and approved for sale. The inspection and approval must be made by the State Agricultural Department, Office of the State Entomologist.
- I. Diseases, Nematodes, and Insects: Sod shall be free of diseases, nematodes, and soil-borne insects. State Nursery and Plant Material Laws require that all sod be inspected and approved for sale. The inspection and approval must be made by the State Agricultural Department, Office of the State Entomologist.
- J. Weeds: Sod shall be free of objectionable grassy and broad leaf weeds.

2.3 TOPSOIL

- A. Topsoil shall be obtained from a previously established stockpile on the site, to the extent available. Additional topsoil required shall be obtained from off-site sources.
- B. Topsoil, whether stripped from site or supplied from off-site, shall be a sandy loam or loam soil as defined by the USDA Soil Conservation Service, Soil Classification System, and shall have the following mechanical analysis:

Textural Class	% of Total Weight	Average %
Sand (0.05-2.0 mm dia. range)	45 to 75	60
Silt (0.002-0.05 mm dia. range)	15 to 35	25
Clay (less than 0.002 m dia. range)	5 to 25	15

1. 95% of topsoil shall pass a 2.0 mm sieve.
2. Topsoil shall be free of stones 1 in. in longest dimension, earth clods, plant parts, and debris. All topsoil shall be screened using a 3/8" screen.
3. Organic matter content shall be an average of 8% of total dry weight with a minimum of any sample being 6%.

C. Topsoil shall have a pH value range of 6.0 to 6.5.

1. If planting soil mixture does not fall within the required pH range, limestone or aluminum sulfate shall be added to bring the pH within the specified limit.
2. If pH is below desired level add ground limestone. If pH is above desired level add aluminum sulfate.

2.4 LIMESTONE

A. Ground limestone shall be an agricultural limestone containing a minimum of 85% total carbonates, by weight. Ground limestone shall be graded within the following limits:

<u>Sieve Size</u>	<u>% Passing by Weight</u>
No. 10	100
No. 20	90
No. 100	60

2.5 WATER

A. Water shall be suitable for irrigation and free from ingredients harmful to seeded or sodded areas.

2.6 ALUMINUM SULFATE

A. Aluminum sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer, and net weight of contents.

2.7 COMMERCIAL FERTILIZER

A. Fertilizer shall conform to the following:

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1. When applied as a topsoil amendment, fertilizer shall have an analysis that will deliver appropriate amounts of nitrogen, phosphorus, and potassium as required to remedy deficiencies revealed by testing the topsoil.
2. When used as a top dressing for the maintenance of sod, fertilizer shall conform to the following:

<u>Constituent</u>	<u>% Present by Weight</u>
Nitrogen (N)	10
Phosphorous (P)	10
Potassium (K)	20

- a. 50% of nitrogen shall be derived from natural organic source of ureaform.
 - b. Potassium shall be derived from muriate of potash containing 60% potash.
- B. Fertilizer shall be delivered in manufacturer's standard container printed with manufacturer's name, material weight, and guaranteed analysis.
- C. Fertilizers with N-P-K analysis other than that stated above may be used provided that the application rate per square foot of nitrogen, phosphorus, and potassium is equal to that specified.

2.8 MULCHES

- A. Straw Mulch: Air-dried, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

2.9 PESTICIDES, FUNGICIDES

- A. General: Pesticide or fungicide 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. Restricted pesticides or fungicides shall not be used unless authorized in writing by authorities having jurisdiction.

PART 3 – EXECUTION

3.1 PREPARATION OF SUBGRADE

- A. Subgrade shall be examined to ensure that rough grading and all other subsurface work in lawn areas and other areas to be seeded is done prior to start of seeding and sodding.
- B. Existing subgrade shall be loosened or scarified to a minimum depth of 3 in. prior to spreading topsoil. Subgrade shall be brought to true and uniform grade, and shall be cleared of stones greater than 2 in., sticks, and other extraneous material.

3.2 PREPARATION OF TOPSOIL

- A. Topsoil shall not be spread until it is possible to follow immediately or within 24 hours with seeding or sodding operations. If topsoil is spread prior to this time it shall be cultivated to loosen soil prior to seeding or sodding.
- B. Topsoil shall not be placed when subgrade or topsoil material are frozen, excessively wet, or excessively dry.
- C. Topsoil shall be spread in a uniform layer, to a thickness, which will compact to the depth required to bring final lawn and grass surfaces to required elevation. Unless otherwise indicated minimum depth of topsoil shall be 6 in. after compaction.
- D. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.
- E. Topsoil shall be applied and rototilled in accordance with the notes on Drawing C-1.1 and shall not be over compacted to the extent that either drainage or turf establishment will be hindered.

3.3 APPLICATION OF FERTILIZER AND CONDITIONERS

- A. Fertilizer and conditioners shall be applied at the following rates:
 - 1. Aluminum Sulfate – as required by test results of topsoil.
 - 2. Limestone - as required by test results of topsoil.
 - 3. Fertilizer - as required by test results of topsoil.
Suggested rate: 2 pounds active Nitrogen per 1000 square feet.
- B. For maintenance of lawn grasses, fertilizer shall be applied at 1 pound active Nitrogen per 1000 square feet. Application frequency: 3 times per year. Apply lime as determined by annual soil tests.
- C. Mixing with topsoil:
 - 1. Fertilizer and conditioners shall be spread (and adjust fertilizer frequency requirements) over the entire areas designated at the application rates indicated above.
 - 2. Materials shall be uniformly and thoroughly mixed into the top 4 in. of topsoil by disking, rototilling, or other approved method.

3.4 FINISH GRADING

- A. Final surface of topsoil immediately before seeding shall be within $\pm 1/2$ in. of required elevation, with no ruts, mounds, ridges, or other faults, and no pockets or low spots in which water can collect. Stones, roots, and other debris greater than 1 in. in any dimension, which are visible at the surface, shall be removed and the resulting holes filled with topsoil, leaving a uniform planar surface.
- B. Finish grade surface with a drag or rake. Round out all breaks in grade, smooth down all lumps and ridges, fill in all holes and crevices. Rolling with a light roller is acceptable, if the surface is scarified afterward.

- C. In the event of settlement, the Contractor shall readjust the work to required finished grade.

3.5 SEED APPLICATION

- A. Seed shall be broadcast by means of an approved mechanical slice seeder, to give a uniform application at the following rates:

<u>Seed Application Rate</u>	<u>lb./1,000 S.F.</u>
Temporary Seeding	4.00
Permanent Seeding – Athletic Fields	8.00
Permanent Seeding – Lawn	5.00
Permanent Seeding – Low Maintenance	5.00
Erosion Control Mix – A	1.00
Erosion Control Mix – B	1.00

- B. Seed shall be applied in two equal applications for uniform coverage; direction of travel of spreader for second pass shall be perpendicular to that of the first pass. Seeding shall not be done when it is raining or snowing, or when wind velocity exceeds 5 mph.

- 1. At the Contractor's option, and with the permission of the Engineer/Landscape Owner, seed may be spread by the hydroseeding method in areas where slice seeding is not practicable, utilizing power equipment commonly used for that purpose. Seed, lime, fertilizer, and mulch shall be mixed and applied to achieve application quantities specified herein for the conventional seeding method, with mulch applied at the rate of 1,200 lb./acre. Other provisions specified above for conventional seeding shall apply also to hydroseeding.

- C. Following seeding the area shall be lightly raked to mingle seed with top 1/8 to 1/4 in. of soil. Area shall then be fine graded. Stones and other debris greater than 1 in. in any dimension which are visible on surface shall be removed. Surface shall be rolled with a hand roller having a weight of 60 to 90 lb./ft. of width, and a minimum diameter of 2 ft.

- D. Following seeding and raking, entire area shall be watered by use of lawn sprinklers, or other approved means. Initial watering shall continue until the equivalent of a 2 in. depth of water has been applied to entire seeded surface, at a rate which will not dislodge the seed. Watering shall be repeated thereafter as frequently as required to prevent drying of the surface, until the grass attains an average height of 1 inch. Watering methods and apparatus which may cause erosion of the surface shall not be permitted.

3.6 SODDING

- A. Edges of the sodded areas shall be smooth, and all sodded areas shall conform to the design cross sections and grade. At edges adjacent to curbs, paved areas, etc., top surface of earth in sod shall be 1/2 in. below adjacent hard surface.

- B. Sod shall be placed and all sodding operations completed within 72 hours following stripping from sod source bed.

- C. On slopes steeper than 2 to 1, sod shall be fastened in place with suitable wood pins or other approved methods, spaced at not less than 1 pin per square foot.

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- D. Surface of completed sodded area shall be smooth. Sod shall be laid edge-to-edge, with tight-butted, staggered joints. Sod shall be carefully placed to insure that it is neither stretched or overlapped. Immediately after laying sod shall be pressed firmly into contact with sod bed by tamping or rolling, to eliminate air pockets. Following compaction, topsoil shall be used to fill all cracks, and excess soil shall be worked into grass with rakes or other suitable equipment. Sod shall not be smothered with excess fill soil.
- E. Immediately after sodding operations have been completed, entire surface shall be compacted with a cultipacker roller or other approved equipment weighing 100 to 160 lb./ft. of roller.
- F. Completed sod shall immediately be watered sufficiently to uniformly wet the soil to at least 1 in. below the bottom of sod bed.

3.7 MAINTENANCE

- A. Except as otherwise specified below, maintenance shall include all operations required to produce an established lawn, including but not limited to: Fertilizing, resodding, mowing, weeding, watering, or reseeding.
- B. Maintenance of seeded areas shall begin upon completion of seeding or and shall continue until full turf establishment and acceptance of the lawn or seeded area, until mowing as specified below is completed, or until average height of grass is 1-1/2 in., whichever occurs later.
- C. Maintenance of sodded areas shall begin upon completion of sodding and shall continue for 45 days thereafter, unless sodding is not completed until after September 15, in which case maintenance shall continue until the June 15 following.
- D. After grass has sprouted, seeded areas, which fail to show a uniform stand of grass shall be replanted as often as necessary to establish an acceptable stand of grass.
 - 1. Scattered bare spots, shall not exceed 50 sq. in. each.
 - 2. Multiple bare spots shall not exceed 5 sq. ft. within a 500 sq. ft. area.
- E. First mowing shall be done when average height of grass is 3 in., with mower set to cut at a height of 2 in. Subsequent mowings shall be made at not over one week intervals, with the height of cut set at 2 in. With prior permission of the Owner, mowings during periods of slow growth or dormancy may be spaced at greater intervals.
- F. If lawn or grass is established in the fall and maintenance is required to continue into spring months, lawn and grass shall receive an application of lime and fertilizer in the spring. Lime and fertilizer shall be spread in a uniform layer over the entire lawn surface, at the rates recommended by a soil test administered at that time.

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3.8 PAYMENTS

A. Payment for loam & seed shall be as follows:

- 50% after all loam has been place and initial seeding.
- 25% after three mowings, fertilizer, and weed killer applied.
- 25% after acceptance by the Owner.

END OF SECTION 329200

SECTION 329300 – TREES, PLANTS, AND GROUND COVERS

PART 1 - GENERAL

1.1 WORK INCLUDED

- A. Provide all materials and equipment, and do all work required to complete the planting, as indicated on the Drawings and as specified.

1.2 RELATED WORK

- A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:
 - 1. Section 31 10 00 – SITE CLEARING. Clearing and grubbing, and stripping of topsoil.
 - 2. Section 31 20 00 – EARTH MOVING. Establishment of subgrade elevations and excavation and backfill.
 - 3. Section 32 92 00 – TURF AND GRASSES. Seeding and sodding.

1.3 REFERENCES

- A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.
 - 1. American National Standards Institute, Inc. (ANSI):
 - Z60.1 American Standard for Nursery Stock
(Sponsor: American Association of Nurserymen, Inc.)
 - 2. American Society for Testing and Materials (ASTM):
 - C 136 Sieve Analysis of Fine and Coarse Aggregates
 - E 11 Wire-Cloth Sieves for Testing Purposes
 - 3. American Wood Preservers' Association (AWPA):
 - C2 Lumber, Timbers, Bridge Ties and Mine Ties –
Preservative Treatment By Pressure Processes
 - 4. "Hortus Third", A Concise Dictionary of Plants Cultivated in the United States and Canada, Cornell University, L.H. Bailey Hortorium, MacMillian Publishing Co., New York, NY.

1.4 SUBMITTALS

- A. Samples: The following samples shall be submitted:

<u>Material</u>	<u>Sample Size or Quantity (lb)</u>
Mulch	1
Planting soil	1
Topsoil from on-site sources	1
Topsoil from off-site sources	1
Each plant species	Actual representative sample, or picture with scale; include information on sources

- B. Manufacturer's Product Data: Manufacturer's product data shall be submitted for the following materials:

Aluminum sulfate
Antidessicant
Fertilizer
Fungicide
Insecticide
Compost

- C. Certificates: Labels from the manufacturer's container certifying that the product meets the specified requirements shall be submitted for the following materials:

Compost
Commercial fertilizer
Limestone

- D. Test Reports: Test reports from an approved testing agency indicating compliance with the specifications shall be submitted for topsoil, planting soil mixture, and any other materials designated by the Engineer/Landscape Architect.

1.5 OWNER'S INSPECTION AND TESTING

- A. Work will be subject to inspection at all times by the Engineer/Landscape Architect. The Owner reserves the right to engage an independent testing laboratory in accordance with requirements of Section 01 45 00, QUALITY CONTROL to analyze and test materials used in the construction of the work. Where directed by the Engineer/Landscape Architect, the testing laboratory will make material analyses and will report to the Engineer/Landscape Architect whether materials conform to the requirements of this specification.

1. Cost of tests and material analyses made by the testing laboratory will be borne by the Owner when they indicate compliance with the specification, and by the Contractor when they indicate non-compliance.
2. Testing equipment will be provided by and tests performed by the testing laboratory. Upon request by the Engineer/Landscape Architect, shall provide such auxiliary personnel and services needed to accomplish the testing work.

3. Gradation of granular materials shall be determined in accordance with ASTM C 136. Sieves for determining material gradation shall be as described in ASTM E 11.

1.6 CONTRACTOR'S INSPECTION AND TESTING

- A. Testing, analyses, and inspection required by the Contractor for his own information or guidance shall be at his own expense.
- B. The Contractor shall engage an independent testing agency, experienced in the testing of agricultural soils and acceptable to the Engineer/Landscape Architect, to perform the following tests and analyses:

<u>Material</u>	<u>Tests and Analysis Required</u>
Topsoil	Mechanical analysis of soil indicating the percent passing by weight of the following sieve sizes: 1 in., 1/2 in., No. 4, No. 10, No. 100, and No. 200. Determination of pH, organic content, and nutrient content. Recommendations shall be made by the testing agency as to the type and quantity of soil additives required to bring nutrient content and pH to satisfactory levels for planting.
Compost	Determination of moisture absorption capacity, organic matter content, and pH.

1. Materials shall not be used in construction until test results have been reviewed by the Engineer/Landscape Architect.
2. All costs associated with testing shall be at Contractor's expense.

1.7 SOURCE QUALITY CONTROL

- A. Identification of plant names shall be as listed in "Hortus Third".
- B. Selection of Plant Materials: Submit to the Engineer/Landscape Architect the names and locations of nurseries proposed as sources of acceptable plant material. Inspect all nursery materials to determine that the materials meet the requirements of this section. Proposed materials shall be flagged at the nurseries by the Contractor prior to viewing by the Engineer/Landscape Architect.
 1. Schedule with the Engineer/Landscape Architect a time for viewing plant material at the nursery. Trips to nurseries shall be efficiently arranged to allow Engineer/Landscape Architect to maximize his viewing time. A minimum of six weeks shall be allowed for this viewing prior to time that plants are to be dug.
 2. Engineer/Landscape Architect may choose to attach his seal to each plant, or representative samples.

3. Where requested by the Engineer/Landscape Architect, photographs of plant material or representative samples of plants shall be submitted.
4. Viewing and/or sealing of plant materials by the Engineer/Landscape Architect at the nursery does not preclude the Engineer/Landscape Architect's right to reject material at the site of planting.

1.8 UNAVAILABILITY OF PLANT MATERIALS

- A. No changes or substitutions may be made without prior approval by the Engineer/Landscape Architect, and municipal authority, if applicable. If unavailability of plant material becomes a concern, then submit satisfactory evidence of advertisement for a one month period in a field-related trade journal or online, without success, or submit written substantiation that specific material is unavailable from at least six reliable and approved sources. Provide alternative availability data or substitution recommendations for approval prior to purchase and installation.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Digging Plant Material: Plants shall not be dug at the nursery or approved source until the Contractor is ready to transport them from their original locations to the site of the work or acceptable storage location.
- B. Transportation of Plant Material: Plants transported to the project in open vehicles shall be covered with tarpaulins or other suitable covers securely fastened to the body of the vehicle to prevent injury to the plants. Closed vehicles shall be adequately ventilated to prevent overheating of the plants.
 1. Plants shall be kept moist, fresh, and protected at all times. Such protection shall encompass the entire period during which the plants are in transit, being handled, or are in temporary storage.
 2. The roots of bareroot stock shall be protected from drying out with wet straw or other suitable material while in transit.
 3. Unless otherwise authorized by the Engineer/Landscape Architect, notify the Engineer/Landscape Architect at least two working days in advance of the anticipated delivery date of any plant material. A legible copy of the bill of lading, showing the quantities, kinds, and sizes of materials included for each shipment shall be furnished to the Engineer/Landscape Architect.
- C. Storage: Unless specific authorization is obtained from the Engineer/Landscape Architect, plants shall not remain on the site of work longer than three days prior to being planted.
 1. Plants that are not planted immediately shall be protected as follows:
 - a. Earth balls shall be kept moist and their solidity carefully preserved.
 - b. Plants shall not be allowed to dry out or freeze.

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2. Bareroot plants may remain on the site of the work only 24 hours before being planted or placed in storage. During this 24-hour period, injury and desiccation of plants on-site shall be prevented.
 - a. Roots of plants in storage shall first be puddled in a paste solution of prepared planting soil and then watered.
 - b. Plants shall then be protected and kept moist by "heeling-in" the roots or by placing the plant in a cool moist storage building. The "heeling-in" procedure shall require the plants to be separated and the roots heeled in a suitable moist soil. If plants are stored in a building, the roots shall be covered with suitable moist mulch.
 3. Both the duration and method of storage of plant materials shall be subject to the approval of the Engineer/Landscape Architect.
- D. Handling of Plant Materials: Exercise care in handling plant materials to avoid damage or stress.

1.10 REJECTION OF MATERIALS

- A. Evidence of inadequate protection following digging, carelessness while in transit, or improper handling or storage, shall be cause for rejection.
- B. Upon arrival at the temporary storage location or the site of the work, plants shall be inspected for proper shipping procedures. Should the roots be dried out, large branches be broken, balls of earth broken or loosened, or areas of bark be torn, the Engineer/Landscape Architect will reject the injured plant.
- C. When a plant has been rejected, remove it from the area of the work and replace it with one of the required size and quality.

1.11 PLANTING SEASON

- A. Spring Planting: Spring planting may commence as soon as the ground has thawed at the nursery and at the site of planting, and weather conditions make it practicable to work both at the nursery and at the site. The planting period shall be April 1 to October 15.
- B. Regardless of the dates specified above, planting shall only be performed when weather and soil conditions are suitable for planting the material specified in accordance with locally accepted practice.
- C. Planting season may be extended only with the written permission of the Engineer/Landscape Architect.

1.12 ACCEPTANCE

- A. The Engineer/Landscape Architect will inspect all work for Substantial Completion upon written notice of completion. The request shall be received at least ten calendar days before the anticipated date of inspection.

- B. Acceptance of plant material by the Engineer/Landscape Architect will be for general conformance to specified size, character, and quality, and shall not diminish responsibility for full conformance to the Contract Documents.
- C. Upon completion and reinspection of all repairs or renewals necessary in the judgment of the Engineer/Landscape Architect, the Engineer/Landscape Architect will recommend to the Owner that acceptance of the work of this Section be given.
- D. Acceptance in Part:
 - 1. The work may be accepted in parts when it is deemed to be in the Owner's best interest to do so, and when permission is given to the Contractor in writing to complete the work in parts.
 - 2. Acceptance and use of such areas by the Owner shall not waive any other provisions of this Contract.

1.13 MAINTENANCE

- A. Plant material shall be maintained until the completion of guarantee period and Final Acceptance of work, as described in Part 3 of this Section.
- B. Following Acceptance, maintenance of plant material shall become the Owner's responsibility. Provide instructions and service as follows.
 - 1. Provide Owner with typewritten recommended maintenance program at time of Substantial Completion.
 - 2. Make as many periodic inspections as necessary during the guarantee period, at no additional cost to the Owner, to inspect the condition of all plant materials. Submit written report of each inspection to the Engineer/Landscape Architect outlining corrective measures required to keep the guarantee valid.

1.14 GUARANTEE

- A. Plants shall be guaranteed for a period of one year after the date of Acceptance by the Owner and Engineer/Landscape Architect.
 - 1. When the work is accepted in parts, the guarantee periods shall extend from each of the partial acceptances to the terminal date of the last guarantee period. Thus, all guarantee periods terminate at one time.
- B. Plants shall be healthy, free of pests and disease, and in flourishing condition at the end of the guarantee period. Plants shall be free of dead and dying branches and branch tips, and shall bear foliage of normal density, size, and color.
- C. Replace dead plants and all plants not in a vigorous, thriving condition, as determined by the Engineer/Landscape Architect during and at the end of the guarantee period, without cost to the Owner, as soon as weather conditions permit and within the specified planting period.

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1. Replacements shall closely match adjacent specimens of the same species. Replacements shall be subject to all requirements stated in this Specification.
 2. Make all necessary repairs due to plant replacements. Such repairs shall be done at no extra cost to the Owner.
 3. The guarantee of all replacement plants shall extend for an additional one-year period from the date of their acceptance after replacement. In the event that a replacement plant is not acceptable during or at the end of the said extended guarantee period, the Owner may elect one more replacement or credit for each item.
- D. At the end of the guarantee period, and no less than five days prior to final inspection, staking and guying materials, and tree wrap and ties shall be removed from the site.

1.15 FINAL INSPECTION AND FINAL ACCEPTANCE

- A. At the end of the guarantee period, the Engineer/Landscape Architect will, upon written notice of end of guarantee period inspect the work for Final Acceptance. Request shall be received at least ten calendar days before the anticipated date for Final Inspection.
- B. Upon completion and reinspection of full repairs or replacements necessary in the judgment of the Engineer/Landscape Architect at that time, the Engineer/Landscape Architect will recommend to the Owner that Final Acceptance of the Work of this Section be given.

PART 2 - PRODUCTS

2.1 PLANTS

- A. Except as otherwise specified, size and grade of plant materials shall conform to ANSI Z60.1. In no case shall ball size be less than 1 1/2 in. in diameter for each inch of caliper.
- B. Plants shall have outstanding form; symmetrical, heavily branched with an even branch distribution, densely foliated and/or budded, and a strong, straight, distinct leader where this is characteristic of species. Plants shall possess a normal balance between height and spread. The Engineer/Landscape Architect will be the final arbiter of acceptability of plant form.
- C. Plants shall be healthy and vigorous, free of disease, insect pests and their eggs, and larvae.
- D. Plants shall have a well-developed fibrous root system.
- E. Plants shall be free of physical damage such as scrapes, broken or split branches, scars, bark abrasions, sunscalds, fresh limb cuts, disfiguring knots, or other defects. These defects shall not interrupt more than 25% of the circumference of the plant cambium.
- F. Plants shall meet the sizes indicated on the Plant List. Plants larger or smaller than specified may be used only if accepted by the Engineer/Landscape Architect.

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- G. Where a size or caliper range is stated, at least 50% of the material shall be closer in size to the top of the range stated.
- H. Plants shall not be pruned before delivery.
- I. Plants indicated as "B&B" shall be balled and burlapped.
 - 1. Unless otherwise permitted by the Engineer/Landscape Architect, plants shall be nursery grown.
 - 2. Plants shall be grown for at least two years under climatic conditions similar to those in the locality of the Project.
 - 3. Nursery grown plants shall be freshly dug. No heeled in plants or plants from cold storage will be accepted, unless otherwise permitted by the Engineer/Landscape Architect.
- J. Container grown plants shall be well rooted and established in the container in which they are growing. They shall have grown in the container for a sufficient length of time for the root system to hold the planting medium when taken from the container, but not long enough to become root bound. Container grown plants exceeding the sizes indicated in ANSI Z60.1 shall have containers which are not less than 75% of the ball sizes for comparable B&B plant material. Each container plant shall be inspected and root pruned as needed.
 - 1. Canes or Trunk(s) and Branches:
 - a. Very well formed and sturdy.
 - b. Branching plentiful and uniformly distributed to form a well-balanced plant.
 - c. Scars shall be free of rot and not exceed 1/4 the diameter of the wood beneath in greatest dimension unless completely healed (except pruning scars).
 - d. Pruning scars clean cut leaving little or no protrusion from the trunk or branch.
 - e. Graft union completely healed.
 - f. No mechanical or pest damage.
 - g. No extreme succulence.
 - 2. Foliage:
 - a. Densely supplied with healthy, vigorous leaves of normal size, shape, color, and texture (except shrubs moved bare-root or deciduous shrubs when dormant).
 - b. No holes, cavities, or depressed areas caused by broken or dead branches or insufficient foliage.
 - c. No chlorosis.
 - d. Pest or mechanical damage barely perceptible with no more than 5% of total foliage affected.
 - e. No frost or cold damage discernible.
 - 3. Root System:
 - a. Sturdily established in container.
 - b. Shall not be excessively rootbound except plants deliberately grown rootbound to produce a dwarf plant.
 - c. No large roots growing out of container.

d. Noxious weeds in container.

K. Bareroot stock, where specified or approved by Engineer/Landscape Architect, shall meet the standards of ANSI Z60.1 and shall conform to the following:

1. Root System. The root system of bareroot stock shall be sufficient to insure plant growth.
2. Bareroot Trees. Bareroot trees shall have a heavy fibrous root system that has been developed by proper cultural treatment, transplanting, and root pruning. The spread of the root system shall be 12 times greater than the trunk diameter plus an additional 6 in.
3. Bareroot Shrubs. Bareroot shrubs shall have a well-developed fibrous root system, with a minimum spread conforming to the following:

<u>Plant Height, ft.</u>	<u>Minimum Spread of Roots, in.</u>
1.5 to 2	10
2 to 3	11
3 to 4	14
4 to 5	16
5 to 6	18
6 to 8	20

2.2 TOPSOIL

- A. Topsoil shall be obtained from a previously established stockpile on the site, to the extent that suitable material is available. Additional topsoil required shall be obtained from off-site sources.
- B. Topsoil, whether stripped from site or supplied from off-site, shall be a sandy loam as defined by the USDA Soil Conservation Service, Soil Classification System, and shall have the following mechanical analysis:

<u>Textural Class</u>	<u>% of Total Weight</u>	<u>Average %</u>
Sand (0.05-2.0 mm dia. range)	45 to 75	60
Silt (0.002-0.05 mm dia. range)	15 to 35	25
Clay (less than 0.002 mm dia. range)	5 to 25	15

1. 95% of topsoil shall pass a 2.0 mm sieve.
2. Topsoil shall be free of stones 1 in. in longest dimension, earth clods, plant parts, and debris.
3. Organic matter content shall be 4 to 12% of total dry weight.

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2.3 COMPOST

- A. Compost shall be highly organic dark brown to black containing 6-10% organic matter tested on a dry weight basis with pH between 6.0 – 8.0, free of plants, their roots, debris; other extraneous matter >1 in. diameter and shall be uncontaminated by foreign matter, or substances harmful to plant growth. Do not use soil for planting while in a frozen or muddy condition.

2.4 PLANTING SOIL

- A. Planting soil shall be a mixture of 3 parts topsoil and 1 part compost, by volume.
- B. Planting soil shall have pH value range of 5.5 to 7.0
 - 1. If planting soil mixture does not fall within the required pH range, limestone or aluminum sulfate shall be added to bring the pH within the specified limit.

2.5 LIMESTONE

- A. Ground limestone shall be an agricultural limestone containing a minimum of 85% total carbonates, by weight. Ground limestone shall be graded within the following limits:

<u>Sieve Size%</u>	<u>Passing by Weight</u>
No. 10	100
No. 20	90
No. 100	60

2.6 WATER

- A. Water shall be suitable for irrigation and shall be free from ingredients harmful to plant life.

2.7 ALUMINUM SULFATE

- A. Aluminum sulfate shall be unadulterated and shall be delivered in containers with the name of the material and manufacturer and net weight of contents.

2.8 COMMERCIAL FERTILIZER

- A. Fertilizer content shall conform to the following:

<u>Constituent</u>	<u>% Present by Weight</u>
Nitrogen (N)	10
Phosphorus (P)	0
Potassium (K)	10

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1. 50% of nitrogen shall be derived from natural organic source of ureaform.
 2. Fertilizer shall be phosphorus-free.
 3. Potassium shall be derived from muriate of potash containing 60% potash.
- B. Fertilizer shall be delivered in manufacturer's standard container printed with manufacturer's name, material weight, and guaranteed analysis.
- C. Fertilizers with N-P-K analysis other than that stated above may be used provided that the application rate per square foot of nitrogen, phosphorus, and potassium is equal to that specified.
- D. Controlled-release fertilizer shall be equal to the following:
- | <u>Product</u> | <u>Manufacturer</u> |
|----------------------------|----------------------------------|
| Agriform 20-10-5 | Sierra Chemical Co. |
| Planting Tablets | Milpitas, CA 95035 |
| EZY-Grow Fertilizer Packet | EZY-Grow - Landscape Specialties |
- Phosphorus-free controlled-release fertilizer is preferred, if available.
- E. Slow release fertilizer for seasonal plantings shall be Osmocote slow release 14-14-14 analysis (or preferred phosphorus-free).

2.9 MULCH

- A. Mulch shall be a 100% fine-shredded pine bark, of uniform size and free from rot, leaves, twigs, debris, stones, or any material harmful to plant growth. Bark shall have been shredded and stockpiled no less than two months and no more than two years before use.

2.10 GUYING AND STAKING MATERIALS

- A. Wood Stakes: For trees under 10 ft. in height, straight, sound, rough sawn lumber not less than 2 x 2 in., if square, or 2-1/2 in. diameter, if round. Wire for staking shall be 12-gauge steel or polyethylene ties per the detail.
- B. Wire for Guying: Galvanized steel 1 x 19 preformed 3/16 in. diameter.
- C. Turnbuckles: Galvanized steel fitted with eyebolts.
- D. Deadman: Sound, rough sawn lumber 2 x 4 in., or other material approved by the Engineer/Landscape Architect.
- E. Hose: High quality braided rubber hose, 3/4 in. diameter and suitable length, black in color.

2.11 ANTIDESICCANT

- A. Antidesiccant shall be an emulsion specifically manufactured for plant protection which provides a protective film over plant surfaces which is permeable enough to permit transpiration. Antidesiccant shall be delivered in manufacturer's sealed containers and shall contain manufacturer's printed instructions for use.
- B. Antidesiccant shall be equal to the following:

<u>Product</u>	<u>Manufacturer</u>
Wilt-Pruf	Wilt-Pruf Products, Inc. P.O. Box 469 Essex, CT 06426

2.12 FUNGICIDE

- A. General: Chemicals 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 chemicals unless authorized in writing by authorities having jurisdiction.
 - 1. Fungicide shall be zinc ethylene bisdithiocarbonate (Zineb), or equal.

PART 3 - EXECUTION

3.1 EXAMINATION OF SUBGRADE

- A. Examine subgrade and rough grading before planting. Alert Engineer/Landscape Architect to unacceptable rough grading or subgrade.

3.2 DRAINAGE OF SOILS

- A. Test drainage of five plant beds and pits chosen by the Engineer/Landscape Architect shall be done by filling with water twice in succession. The time at which water is put into the pit or bed for a second filling shall be noted. Engineer/Landscape Architect shall then be notified of the time it takes for pit or bed to drain completely. Planting operations shall not proceed until Engineer/Landscape Architect has reviewed test drainage results.
- B. Notify the Engineer/Landscape Architect in writing of all soil or drainage conditions that he considers detrimental to growth of plant material. Submit proposal and cost estimate for correction of the conditions for Engineer/Landscape Architect 's approval before starting work.

3.3 LAYOUT OF PLANTING AREAS

- A. Individual plant locations and outlines of shrub and ground cover areas to be planted shall be staked by the Contractor in ample time to allow inspection by the Engineer/Landscape Architect.
- B. Digging shall not begin until locations are approved by the Engineer/Landscape Architect.
- C. Location of trees shall be staked using color-coded stakes. A different stake color shall be used for each tree species.

3.4 PREPARATION OF SUBGRADE

- A. Subgrade of planting areas shall be loosened or scarified to a minimum depth of 3 in. prior to spreading planting soil. Subgrade shall be brought to true and uniform grade and shall be cleared of stones greater than 2 in., sticks, and other extraneous material.

3.5 PLANT PIT EXCAVATION

- A. Planting pits for trees and shrubs shall be excavated to the depth and dimension indicated on the Drawings.
- B. Excavation shall not begin until locations are approved by the Engineer/Landscape Architect.

3.6 FILTER FABRIC

- A. Filter fabric shall be installed where indicated on the Drawings. Unless otherwise indicated on the Drawings, filter fabric shall be overlapped 6 in. along all edges.

3.7 SPREADING OF PLANTING SOIL

- A. Planting soil shall be spread and placed to required depths.
- B. Surfaces shall be graded and smoothed, eliminating all sharp breaks by rounding, scraping off bumps and ridges, and filling in holes and cuts.

3.8 PLANTING

- A. Walls of plant pits shall be dug so that they are vertical and scarified.
- B. Plants shall be set as indicated on Drawings. Plants shall have same relationship to finished grade as in the nursery.
- C. Plants shall be turned to the desired orientation when required by Engineer/Landscape Architect.

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- D. Containerized plants shall be removed from container taking care not to damage roots. The side of the root ball shall be scarified to prevent root-bound condition and plant positioned in planting pit.
- E. Planting shall be positioned in center of planting pit, set plumb, and rigidly braced in position until all planting soil has been tamped solidly around the ball.
- F. Pits for shrubs shall be backfilled with planting soil. Tree pits shall be backfilled with existing soil, no planting soil. Soil shall be worked carefully into voids and pockets, tamping lightly every 6 in.
 - 1. When pit is two-thirds full, plants shall be watered thoroughly, and water left to soak in before proceeding.
 - 2. At this time, ropes or strings on top of ball shall be cut and removed. Burlap or cloth wrapping shall be completely removed once plant is set in pit. Non-biodegradable ball wrapping and support wire shall be totally removed from ball and planting pit.
 - 3. Remove nursery plant identification tags.
- G. Backfilling and tamping shall then be finished and a saucer formed around plant pits as indicated on the Drawings.
- H. Saucer shall be filled with water and water left to soak in. Saucer shall then be filled with water again.
- I. Following planting of aquatic plant material, 3 in. layer of gravel shall be spread to stabilize soil beneath.

3.9 BULBS AND HERBACEOUS PERENNIALS

- A. Prepare perennial planting beds by application of fertilizers and pH-altering amendments and thoroughly rototilling into the top 12 in. prior to planting bulbs and flowering plants.

3.10 APPLICATION OF FERTILIZER

- A. Fertilizer shall be applied when planting pits are backfilled two-thirds full. Fertilizer application shall be of the type, rate, and timing recommended by the testing agency for each plant type.
- B. Slow-release fertilizer
 - 1. Fertilization schedule for trees and shrubs using slow release 4 oz. packet system shall be per manufacturer's recommendations.
 - 2. Fertilizer packets shall be placed 6 to 8 in. deep below top of planting soil around root balls of plants. Packets shall be spaced evenly depending on the number of packets required.

3.11 FUNGICIDE SPRAYING

- A. Immediately after planting, all trunks of deciduous trees shall be sprayed with fungicide, applied as directed by chemical manufacturer.

3.12 STAKING AND GUYING

- A. Each tree shall be staked or guyed immediately following planting. Plants shall stand plumb after staking or guying.
- B. Duckbill Tree Support Systems shall be installed in strict conformance with manufacturer's published installation instructions.
- C. Duckbill Root Ball Fixing Systems shall be installed in strict conformance with manufacturer's published installation instructions.

3.13 MULCHING

- A. Mulch shall be applied as follows (entire area listed shall be mulched):

<u>Plant Type</u>	<u>Mulch Area</u>	<u>Mulch Depth, in.</u>
Tree	Saucer	3
Shrub	Saucer or Bed	3
Groundcover	Bed	3

3.14 PRUNING

- A. Each tree and shrub shall be pruned to preserve the natural character of the plant. Pruning shall be done after delivery of plants and after plants have been inspected and approved by the Engineer/Landscape Architect. Pruning procedures shall be reviewed with Engineer/Landscape Architect before proceeding.
- B. Pruning shall be done with clean, sharp tools. Cuts shall be made flush, leaving no stubs. No tree paint shall be used.
- C. Dead wood, suckers, and broken and badly bruised branches shall be removed.

3.15 MAINTENANCE OF PLANTING

- A. Maintenance shall begin immediately after each plant is planted and shall continue until Final Acceptance. The Contractor shall provide water for irrigation if none is available on site.
- B. Maintenance shall consist of pruning, watering, cultivating, weeding, mulching, removal of dead material, repairing and replacing of tree stakes, tightening and repairing of guys, resetting plants to proper grades and upright position, and furnishing and applying such sprays as are necessary to keep plantings free of insects and disease, and in a healthy growing condition.

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- C. Planting areas shall be kept free of weeds, grass, and other undesired vegetative growth.
- D. Note: Extend maintenance beyond Substantial or Final Acceptance of Project if necessary to meet above requirements. Engineer/Landscape Architect may withhold funds from Substantial and Final Completion payments as necessary to assure proper performance of maintenance operations.

END OF SECTION 329300

SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Piping joining materials.
2. Sleeves.
3. Identification devices.
4. Grout.
5. Piping system common requirements.
6. Equipment installation common requirements.
7. Concrete bases.
8. Supports and anchorages.

1.2 RELATED DOCUMENTS – Vacant

1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Storm drain, Underdrain, water, sewer & force main, pipe and fittings.
2. Appurtenances including manholes, catch basins, grease traps, pump stations, outlet control structures, septic tanks, pretreatment systems, cleanouts, control panel and enclosures, vent pipes, access hatches, water quality filter control manholes, transformer pad, concrete disposal chambers, pipe manifolds, pipe insulation, flared inlets, rain guards, manhole bases, hold down pads for underground propane, water and fuel tanks.
3. Submittals for appurtenances shall show the angle for any pipe entrances as well as the height or elevation of the penetration.

1.5 QUALITY ASSURANCE

A. Testing of Sanitary Sewer System (Gravity Main)

1. Sanitary Sewer Testing: Testing of a section of sewer between manholes shall be performed using the below stated equipment according to stated procedures and under the supervision of the Owner’s representative and the Winthrop Utilities District.
2. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
3. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
4. All air used shall pass through a single control panel.
5. Three (3) individual hoses shall be used for the following connections:
 - a. From control panel to pneumatic plugs for inflation.
 - b. From control panel to sealed line for introducing the low pressure air.
 - c. From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.
 - d. 2. Procedures: All pneumatic plugs shall be seal tested before being used in the actual test installation. One (1) length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The sealed pipe shall be pressurized to 5 psig. The plugs shall hold against the pressure without bracing and without movement of the plugs out of the pipe.
 - e. After a manhole to manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low pressure reaches 4 psig greater than the average back pressure of any ground water that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.

After the stabilization period (3.5 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "acceptable" if the time required in minutes for the pressure to decrease from 3.5 to 2.5 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following table:

Diameter (inches)	Minimum Allowable Pipe Minutes to Decrease from 3.5 – 2.5 psig Pressure In
4	2.0
6	3.0
8	4.0
10	5.0
12	6.0
15	7.5
18	9.0
21	10.5

6. In areas where ground water is known to exist, the Contractor shall install a one-half (1/2) inch diameter capped pipe nipple, approximately ten (10) inches long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple.

The hose shall be held vertically, and a measurement of the height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11-1/2 feet, then the added pressure will be 5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one pound and the timing remain the same.)

7. If installation fails to meet the above requirements for the air test, the Contractor shall correct the pipeline until an acceptable test is achieved.
8. The Contractor shall provide as required the proper plugs, weirs, and other equipment required to perform all tests. Testing of each section of sewer installed shall include the portions of service connections that are to be installed under the Contract.
9. Where ground water is confirmed to be high, the Engineer at his option may elect to accept infiltration measurements in lieu of air testing.
10. These tests shall be conducted at all times in the presence of the Engineer. Should a line which has previously been tested indicate any water infiltration, or otherwise appear suspect to the Engineer, the Contractor shall conduct confirmation air tests on the line at no additional costs.

1.6 DEFLECTION TESTING

- A. Deflection tests shall be performed on all flexible pipe. The test shall be conducted after the final backfill has been in place at least 30 days.
- B. No pipe shall exceed a deflection of 5 percent.
- C. If the deflection test is to be run using a right ball or mandrel, it shall have a diameter equal to 95 percent of the inside diameter of the pipe. The test shall be performed without mechanical pulling devices.
- D. Manhole and Appurtenance Testing: All sanitary manholes, wet wells, septic tanks, holding tanks, and other appurtenant structures shall be tested as to water tightness. If the initial test fails a retest shall be required. The Contractor has the option of either of the following methods:
 1. Water Test: The inlet and outlet of the structure shall be plugged by watertight plugs furnished by the Contractor, and the manhole shall be filled with water. The water shall remain for sufficient time for the absorption into the concrete pipe to have been substantially completed. The amount of water loss from the manhole shall then be determined. The rate shall not exceed five (5) gallons per hour. Obvious leaks shall be repaired by the Contractor by excavating outside the structure, if required, at no cost to the Owner.

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2. Vacuum: The manholes shall be vacuum tested by a method and apparatus subject to the prior approval of the Engineer. Vacuum testing shall be performed in the following manner:

The manhole shall be fully assembled, including all pipe connections into the structure. The manhole shall be in its final location and shall not have been backfilled prior to the performance of the test.

All lift holes shall be plugged with a non-shrinking mortar, as approved by the Engineer.

The seal between the manhole sections shall be in accordance with ASTM C923.

The Contractor shall plug the pipe openings, taking care to securely brace the plugs and the pipe.

With the vacuum tester set in place:

- Inflate the compression band to effect a seal between the vacuum base and the structure.
- Connect the vacuum pump to the outlet port with the valve open.
- Draw a vacuum to 10" of Hg. and close the valve.
- The test shall pass if the vacuum remains at 10" Hg. or drops to 9" Hg. in a time greater than one minute. If the manhole fails the initial test, the Contractor shall locate the leak and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material.

Any appurtenant structure which shows obvious infiltration, whether tested or not, shall be sealed to eliminate said infiltration.

- E. Water and Forced Main Testing: Test water distribution system and force main pipe sizes installed below grade and into the building to the base of the riser in accordance with following procedures:

1. Before pressure testing the water main, air shall be completely expelled from the pipe. If permanent air valves are not located at all high points, corporation stops shall be installed at all high points so that the air can be expelled as the pipe is being filled. After completion of the test, the corporation stops shall either be removed or left in place at the discretion of the Owner.
2. If fire hydrants are installed on the new water main, the test shall be conducted against a closed hydrant valve.
3. The test pressure shall be 1.5 times the static pressure at the lowest point of elevation of the line and shall not be less than 150 p.s.i.

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4. The test shall not exceed the pipe or thrust restraint design pressures, nor exceed twice the rated pressure of the valves or hydrants and shall not exceed the rated pressure of the valves, if resilient - sealed butterfly valves are used.
5. Water, only, shall be used to bring the main to the required test pressure. The type of pump shall be approved by the Mechanical Engineer.
6. The test shall be of at least two hours in duration. A leakage test shall be conducted immediately after the pressure test.
7. After the pressure test period, water shall be pumped into the main to bring the pressure back up to the initial test pressure. No pipe installation shall be accepted if the leakage is greater than that listed in Table 1 attached to this Section.

If any pipe installation shows a leakage greater than that specified in Table 1, the contractor at his own expense shall locate and repair the leak until it is within the specified allowance.

The pressure and leakage tests shall be conducted under Owner supervision.

- F. Utility Grade/Alignment Check of the Design Alignment. Survey checks, mirrors, or lasers may be employed to verify conformance with these standards.

PART 2 - PRODUCTS

2.1 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, unless otherwise indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
 2. CPVC Piping: ASTM F 493.
 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 4. PVC to ABS Piping Transition: ASTM D 3138.

- E. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.2 SLEEVES

- A. Galvanized-Steel Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
- E. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.
- F. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.3 IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
 - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
 - 2. Location: Accessible and visible.
- B. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least 3 mils (0.08 mm) thick.
 - 1. Width: 1-1/2 inches (40 mm) on pipes with OD, including insulation, less than 6 inches (150 mm); 2-1/2 inches (65 mm) for larger pipes.
 - 2. Color: Comply with ASME A13.1, unless otherwise indicated.
- C. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) sequenced numbers. Include 5/32-inch (4-mm) hole for fastener.
 - 1. Material: Valve manufacturer's standard solid plastic.
 - 2. Size: 1-1/2 inches (40 mm) in diameter, unless otherwise indicated.
 - 3. Shape: As indicated for each piping system.
- D. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- E. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

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1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
 2. Thickness: 1/8 inch (3 mm), unless otherwise indicated.
 3. Thickness: 1/16 inch (1.6 mm), for units up to 20 sq. in. (130 sq. cm) or 8 inches (200 mm) in length, and 1/8 inch (3 mm) for larger units.
 4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- F. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cooling equipment and components.
 2. Yellow: Heating equipment and components.
 3. Brown: Energy reclamation equipment and components.
 4. Blue: Equipment and components that do not meet criteria above.
 5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
 6. Terminology: Match schedules as closely as possible. Include the following:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 7. Size: 2-1/2 by 4 inches (65 by 100 mm) for control devices, dampers, and valves; 4-1/2 by 6 inches (115 by 150 mm) for equipment.

2.4 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Install piping according to the following requirements and Division 33 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.

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- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - a. PVC Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
 - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 33 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
- H. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- K. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
1. Plain-End PE Pipe and Fittings: Use butt fusion.
 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- L. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 3. Install dielectric fittings at connections of dissimilar metal pipes.

3.4 EQUIPMENT INSTALLATION

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

3.5 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
 - 1. Plastic markers, with application systems. Install on insulation segment if required for hot non-insulated piping.
 - 2. Locate pipe markers on exposed piping according to the following:
 - a. Near each valve and control device.
 - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
 - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
 - d. At manholes and similar access points that permit view of concealed piping.
 - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
 - 1. Lettering Size: Minimum 1/4 inch (6.4 mm) high for name of unit if viewing distance is less than 24 inches (610 mm), 1/2 inch (13 mm) high for distances up to 72 inches (1800 mm), and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
 - 2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.

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2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in "Cast-in-Place Concrete" Section of the specifications.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

3.8 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330500

SECTION 331100 - WATER DISTRIBUTION SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the water services and mains. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire water line, valves and fire hydrants, set lines, elevations, and grades for water distribution systems work and control system for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.
- B. Meter and backflow devices are to be supplied by the General Contractor and or the Mechanical Contractor to meet the requirements of the Portland Water District.
- C. The Portland Water District will install new service leads from the water main in the street to the right-of-way. The site contractor is responsible for preparing the application for service and all attendant connection fees. The site contractor is also responsible for the trench cap over the new service.

1.2 RELATED SECTIONS

- A. Section 330500 – Common Work Results for Utilities.
- B. Section 321100 – Base Courses.
- C. Section 312000 – Earth Moving.
- D. Section 333900 – Sewer Appurtenances.
- E. Local Governing Authority and Code Requirements.
- F. All Necessary Construction Permits.
- G. The public utility for water is the Portland Water District. All materials, installation, and workmanship will comply with the requirements specified in this section, the requirements of the Public Utilities Commission and the Portland Water District. Where a more stringent standard exists, the more stringent standard shall apply.

1.3 REFERENCE

- A. AASHTO T180 - Moisture-Density Relations of Soils Using a 10-lb (4.54 kg) Rammer and an 18-in. (457 mm) Drop.

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- B. ANSI/ASME B16.18 - Cast Copper Allow Solder Joint Pressure Fittings.
- C. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- D. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54 Kg) Rammer and 18-in. (457 mm) Drop
- E. ANSI/ASTM D2466 - Polyvinyl Chloride (PVC) Plastic Pipe Fittings, Schedule 40.
- F. ANSI/AWS A5.8 - Brazing Filler Metal.
- G. ANSI/AWWA C104 - Cement-Mortar Lining for Ductile-Iron Pipe Fittings for Water.
- H. ANSI/AWWA C105 - Polyethylene Encasement for Ductile Iron Piping for Water and Other Liquid.
- I. ANSI/AWWA C111 - Rubber-Gasket Joints for Ductile Iron and Grey-Iron Pressure Pipe and Fittings.
- J. ANSI/AWWA C151 - Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
- K. ANSI/AWWA C500 - Gate Valves, 3 through 48 in NPS, for Water and Sewage Systems.
- L. ANSI/AWWA C502 - Dry Barrel Fire Hydrants.
- M. ANSI/AWWA C504 - Rubber Seated Butterfly Valves.
- N. ANSI/AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in through 24 in NPS.
- O. ANSI/AWWA C509 - Resilient Seated Gate Valves 3 in through 12 in NPS, for Water and Sewage Systems.
- P. ANSI/AWWA C600 - Installation of Ductile-Iron Water Mains and Appurtenances.
- Q. ANSI/AWWA C606 - Grooved and Shouldered Type Joints.
- R. ANSI/AWWA C900 - Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 inch through 12 inch, for Water.
- S. ASTM B88 - Seamless Copper Water Tube.
- T. ASTM D1785 - Polyvinyl Chloride (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- U. ASTM D2241 - Polyvinyl Chloride (PVC) Plastic Pipe (SDR-PR).
- V. ASTM D2855 - Making Solvent-Cemented Joints with Polyvinyl Chloride (PVC) Pipe and Fittings.

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- W. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- X. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.
- Y. ASTM D3139 - Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
- Z. ASTM D3035 - Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter.
- AA. AWWA C901 - Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, ½ inch through 3 inch, for water.
- BB. UL 246 - Hydrants for Fire - Protection Service.

1.4 SUBMITTALS

- A. Product Data: Provide data on pipe materials, pipe fittings, hydrants, valves, and accessories including ASTM designations, AWWA certifications, and UL labels as required.
- B. Manufacturer's Certificate: Certify that products meet or exceed state or local requirements.

1.5 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of piping mains, valves, connections, and invert elevations. Record a minimum of two (2) lateral measurement “swing ties”, as close to 90 degrees opposed as practical, prior to backfilling pipeline from permanent fixtures such as building corners, telephone poles, fire hydrants, catch basins, manholes etc. to all valves, fittings, couplings, tees etc. for purposes of future location. Permanent fixtures shall be identified such as house numbers or description, pole numbers etc. These ties must be legibly recorded in sketch form and submitted to the District prior to final project acceptance.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.6 QUALITY ASSURANCE

- A. Perform work in accordance with utility company and/or municipality requirements.
- B. Valves: Manufacturer's name and pressure rating marked on valve body.
- C. Quality and Workmanship for HDPE Pipe: The pipe and/or fitting manufacturer’s production facilities shall be open for inspection by the owner or his designated agents with a reasonable advanced notice. During inspection, the manufacturer shall demonstrate that it has facilities capable of manufacturing and testing the pipe and/or fittings to standards required by this specification.

Pipe which has been tested by the manufacturer and falls outside of the appropriate limits set forth in this specification will be cause for rejection.

QA Records: QA/QC records shall be maintained intact for a minimum of one year from the date of production.

- D. Polyethylene Pipe Marking: During extrusion production, the HDPE pipe shall be continuously marked with durable printing including the following information:
1. Nominal Size
 2. Dimension Ratio
 3. Pressure Class, psi
 4. Manufacturer's Name and Product Series
 5. Cell Class
 6. ASTM Basis
 7. "NSF-PW"
 8. Pipe Test Category
 9. Plant Code & Extruder
 10. Production Date
 11. Operator Number (Shift Letter optional)
 12. Resin Supplier Code

For pipe diameters greater than or equal to 3" IPS, PE345464C shall be used as a cell class and F714 shall be used as the ASTM Basis.

- E. Polyethylene Pipe Packaging, Handling & Storage: The manufacturer shall package the pipe in a manner designed to deliver the pipe to the project neatly, intact, and without physical damage. The transportation carrier shall use appropriate methods and intermittent checks to insure the pipe is properly supported, stacked, and restrained during transport such that the pipe is not nicked, gouged, or physically damaged.

Pipe shall be stored on clean, level ground to prevent undue scratching or gouging. If the pipe must be stacked for storage, such stacking shall be done in accordance with the pipe manufacturer's recommendations. The pipe shall be handled in such a manner that it is not pulled over sharp objects or cut by chokers or lifting equipment.

Sections of pipe having been discovered with cuts or gouges in excess of 10% of the pipe wall thickness shall be cut out and removed. The undamaged portions of the pipe shall be rejoined using the heat fusion joining method.

Fused segments of pipe shall be handled so as to avoid damage to the pipe. Chains or cable type chokers must be avoided when lifting fused sections of pipe. Nylon slings are preferred. Spreader bars are recommended when lifting long fused sections.

PART 2 - PRODUCTS

2.1. POLYETHYLENE PIPE

- A. HDPE Pipe: HDPE may be used for services and portions of the main that are on the site. The pipe size shall be one size larger than shown on the plan. For example, use 10” HDPE in lieu of 8” Ductile Iron Pipe.

Polyethylene Pipe Properties			
Property	Test Method	Unit	Nominal Value
Density	ASTM D 1505	gm/cm ³	.955
Melt Index	ASTM D 1238 (Condition E)	gm/10 min	.11
ESCR	ASTM D 1693	F ₀ hours	>5000
PENT	ASTM F 1473	hours	>100
Flexural Modulus	ASTM D 790	psi	110,000
Tensile Strength	ASTM D 638	psi	3,200
HDB @ 73.4 °F	ASTM D 2837	psi	1,600
UV Stabilizer	ASTM D 1603	% C	>2
Hardness	ASTM D 2240	Shore “D”	65
Tensile Strength @ Yield (Type IV Spec.)	ASTM D 638 (2”/min)	psi	3,200
Tensile Strength @ Break (Type IV Spec.)	ASTM D 638	psi	5,000
Elongation @ Break	ASTM D 638	%, minimum	750
Modulus of Elasticity	ASTM D 638	psi	130,000
Linear Thermal Expansion Coefficient	ASTM D 696	in/in/°F	1.2 x 10 ⁻⁴
Thermal Conductivity	ASTM D 177	BTU- in/ft ² /hrs/°F	2.7
Brittleness Temperature	ASTM D 746	°F	< - 180
Heat Fusion Condition	Required interfacial pressure and heater temperature	psi @ °F	75 @ 400°

Specifications:

Material Designation	PPI	PE 3408
Cell Classification	ASTM D 3350	345464C

- B. Polyethylene Pipe Material: Materials used for the manufacture of polyethylene pipe and fittings shall be extra high molecular weight, high-density PE 3408 polyethylene resin.

The material shall be listed by PPI (Plastics Pipe Institute, a division of the Society of the Plastics Industry) in PPI TR-4 with a 73°F hydrostatic design basis of 1,600 psi and a 140°F hydrostatic design basis of 800 psi. The PPI listing shall be in the name of the pipe manufacturer and shall be based on ASTM D 2837 testing.

- C. Polyethylene Pipe and Fittings: Pipe supplied under this specification shall have a nominal DIPS (Ductile Iron Pipe Size) OD unless otherwise specified. The DR (Dimension Ratio) and the pressure rating of the pipe supplied shall be as SDR9 and 200 psi respectively.

The pipe shall be produced from approved HDPE pipe grade resin with the nominal physical properties outlined in Section III. Pipe having a diameter 3” and larger will be made to the dimensions and tolerances specified in ASTM F 714.

All fittings shall be CTS joints.

- D. Polyethylene Pipe Performance: The pipe will be extruded from resin meeting the specifications of ASTM D 3350 with a minimum cell classification of 345464C.
- E. Polyethylene Fittings: HDPE fittings shall be in accordance with ASTM D 3261 and shall be manufactured by injection molding, a combination of extrusion and machining, or fabrication from HDPE pipe conforming to this specification or Ductile Iron. The fittings shall be fully pressure rated and provide a working pressure equal to that of the pipe with an included 2:1 safety factor. The fittings shall be manufactured from the same base resin type and cell classification as the pipe itself. The fittings shall be homogenous throughout and free from cracks, holes, foreign inclusions, voids, or other injurious defects.
- F. Tracer Line: All non metallic water system piping shall be installed with a 1/8” copper tracer line and yellow plastic warning tape installed 12” above the top of pipe.

2.2 DUCTILE IRON PIPE

- A. Ductile Iron Pipe shall meet the requirements of AWWA Standard C-151 (latest revision) and be double cement lined and seal coated to meet AWWA Standard C-104 (latest revision). Joints shall meet the requirements of AWWA C-111 (latest revision).
- B. Interior seal coat shall be at least 2 mils thick and meet the specification 1.1 as stated above.
- C. Exterior of pipe shall be petroleum asphaltic coated with a minimum of 4 mils dry film thickness. The finished coating shall be continuous, smooth, neither brittle when cold or sticky when exposed to the sun, and strongly adherent to the fitting.
- D. Class 52 wall thickness CLDI 4” diameter through 10” diameter all-inclusive.
- E. Class 51 wall thickness 12” diameter through 16” diameter all-inclusive.
- F. Class 50 wall thickness 20” diameter and larger.
- G. Nominal laying length shall have an average no less than 18 ft. per pipe.
- H. Approximately 20 percent of the pipe shall be specified as full gage and clearly marked indicating such.

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- I. Mechanical Joint pipe shall be furnished with standard gland, gaskets and Cor-Ten bolts, and nuts as “standard accessories”.
- J. Push-on joint pipe shall be furnished with gaskets and gasket lubricants as “standard accessories”.
- K. Special order pipe shall be specified as to the standard accessories required.

2.3. DUCTILE IRON FITTINGS

- A. Mechanical Joint compact fittings shall be Ductile Iron Class 350 (350 psig rated working pressure) in accordance with ANSI/AWWA C-153/A-21.53 (latest revision), for fittings 3” thru 16” and ANSI/AWWA C-104/A-21.40 (latest revision) cement lining.
- B. Mechanical Joint standard fittings shall be Ductile Iron Class 350 (350 psig rated working pressure) in accordance with ANSI/AWWA C-110/A-21.10 (latest revision), for fittings 3” thru 48” and ANSI/AWWA C-104/A-21.40 (latest revision) cement lining.
- C. Flanged joint fittings shall be Ductile Iron Class 250 (250 psig rated working pressure) in accordance with ANSI/AWWA C110/A21.20 (latest revision), for fittings 3” thru 24’ and ANSI/AWWA C-104/A-21.40 (latest revision) cement lining.
- D. The District **does not** permit the use of push on fittings.
- E. Interior seal coating with a minimum of 4 mils dry film thickness in accordance with AWWA C-104.
- F. Exterior petroleum asphaltic coated with a minimum of 4 mils dry film thickness. The finished coating shall be continuous, smooth, neither brittle when cold or sticky when exposed to the sun, and strongly adherent to the fitting.
- G. Mechanical joint and flanged joint nuts and bolts shall be high strength, low alloy steel per ANSI 21.11 unless otherwise specified.
- H. All fittings shall be of standard grade 70-50-05 Ductile Iron construction with the following minimum characteristics: 70,000 psi minimum tensile strength; 50,000 psi minimum yield strength; 5% minimum elongation. Test results shall be made available upon request. Cast iron fittings are **not** permitted.
- I. All fittings shall be supplied with “standard accessories” unless otherwise specified.

2.4 DUCTILE IRON RESTRAINING GLANDS

- A. Mechanical Joint Valves and Fittings shall be restrained with “Megalug” restraining glands exclusively. Megalug restraining glands are manufactured by EBBA Iron Sales, Inc. of Eastland, Texas.

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- B. Flanged Joint valves and fittings shall be restrained with flange adapters in lieu of threaded or welded flanges on plain end Ductile Iron pipe when so specified.
- C. Flange Adapters shall be cast from 60-42-10 Ductile Iron as per ASTM 536-77 and shall have boltholes to meet ANSI B16.1. Flange adapters shall be 125 lb faced. These flange adapters shall contain setscrews made from Ductile Iron. The screws shall have a Rockwell hardness of C40-45 converted from Brinnell. Safety factor shall be a minimum of 2:1.
- D. All joint restraining devices shall include a gasket, set screws, and Cor-ten nuts and bolts as standard accessories.

2.5 DUCTILE IRON COUPLINGS (SLEEVES)

- A. Mechanical joint style straight and transition type couplings shall be constructed entirely of Ductile Iron.
- B. Center rings shall be grade 65-45-12 Ductile Iron meeting or exceeding ASTM Standard A536-80. All areas of the center ring shall receive a heavy shop coat of primer and epoxy paint at the factory.
- C. End rings shall be grade 68-45-12 Ductile Iron meeting or exceeding ASTM Standard A536-80. End rings shall be color coded to the outside diameter range of pipe.
- D. Gaskets shall be virgin SBR compound for water service. Gaskets material shall meet or exceed ASTM Standard D2000 3 BA715.
- E. Bolts and nuts shall be high strength, low alloy steel trackhead type bolts. National coarse rolled thread and heavy hex nuts with black finish. The steel shall meet AWWA C111-80 composition specifications.

2.6 THREE PART COUPLINGS

- A. All three-part couplings shall be meet or exceed the latest revision of ANSI/AWWA Standard C-800.
- B. Outlet connections shall be CPPJ. CPPJ three-part couplings shall be designed such that the PJ nut “shoulders” tight against the coupling body. PJ connections utilizing setscrews are not permitted. Connections to existing watermains may require IP compression ends on some.
- C. The coupling body and components shall be of heavy brass construction of 85-5-5 ASTM B62 brass for strength and durability.
- D. Rated working pressure shall be 250-psig minimum.

2.7 BOLTS AND NUTS

- A. General description of properties required.

1. Stainless Steel: Type 316 - contains the addition of molybdenum to the nickel-chromium steels.

Specific Chemical Composition:

a)	Carbon	-	0.08% max.
b)	Manganese	-	2.00% max.
c)	Silicone	-	1.00% max.
d)	Phosphorus	-	0.04% max.
e)	Sulphur	-	0.03% max.
f)	Chromium	-	16-18.00%
g)	Nickel	-	10-14.00%
h)	Molybdenum	-	2-3.00%
i)	SAE No.	-	30316
j)	ASM No.	-	5361A, 5524A, 5573, 5648B, 5690D

2. Cor-Ten Steel: Trade name for cold formed T-head bolts containing alloying elements such as copper, nickel, and chrome.

Specific Chemical Composition:

a)	Carbon	-	0.2% max.
b)	Manganese	-	1.25% max.
c)	Sulphur	-	0.05% max.
d)	Nickel	-	0.25% min.
e)	Copper	-	0.20% min.
f)	Combined (Ni,Cu,Cr)	-	1.25% min.

2.8 INSERTION VALVES

- A. The District currently utilizes the “Quick Valve” Tapping sleeve for temporary insertion valves. Designed to work up to 150psi working pressure. The sleeve shall be designed to accommodate all drilling equipment without interruption of service.
- B. The sleeve shall be made of ASTM A-36 Steel epoxy coated to 10-12 mils. The flange shall be manufactured to work with both the equipment and the insert. All parts shall be sealed and watertight. The valve stem shall be “open left”.
- C. The insert shall be coated with a SBR rubber compound and be sized to ensure no water will leak by the insert wedge.
- D. All parts shall meet all applicable AWWA standards. All bolts shall be high strength Stainless Steel.
- E. Acceptable manufactures are Transmate, a division of Romac Industries Inc. in Seattle Washington or approved equal.

2.9 RESILIENT SEAT WEDGE GATE VALVES

- A. The District currently utilizes the American Flow Control Model 2500 (Waterous Series 500) resilient seat gate valve for 4” diameter through 12” diameter sizes, inclusive. The CRS-80 non-rising stem gate valve is used exclusively for below ground use. The CRS-80 outside screw and yoke style is used exclusively for above ground use (pumping stations, meter pits, etc.)
- B. All bolts shall be high strength Stainless Steel.
- C. The valve stem shall be “open left”.

2.10 VALVE BOXES

- A. Valve boxes shall be cast iron, two-piece, sliding type with a top flange and a minimum inside shaft diameter of 5”.
- B. The bottom section shall be 36” long and provided with a belled (buffalo) base in accordance with the attached sketch.
- C. The top section shall be 36” long and designed to slide over the base section. See attached sketch.
- D. The cover shall be a heavy 2” drop type, non-tilting cast iron unit that is recessed in the box top to prevent plow breakage. The cover shall be provided with two pick holes for easy removal and have the word “WATER” clearly cast into the cover.
- E. All valve box components shall be generously coated with a corrosion resistant bituminous coating.

2.11 SERVICE BOXES

- A. Service Box Specifications
 - Shall be 1.0” I.D. black iron or steel pipe with top having N.P.I. threads for 1.0” screw cover.
 - Shall be Arch Pattern Style with 6’- 0” slide type adjustable riser.
 - All boxes shall be heavily coated with asphalt-base paint
- B. Service Box Cover Specifications
 - Cast Iron construction with N.P.I. female threads to accept service box (1.2 above).
 - Shall be tapped with a 1” rope thread with a solid brass plug with pentagon operating head.
- C. Service Box Foot Piece Specifications
 - The standard foot piece shall be heavy duty (Ford style or equal) cast iron design.

- The large heavy foot piece shall have an arch that will fit over 2" ball valve curb stops.

D. Service Box Rod Specifications

- Shall be 36" long 5/8" diameter # 304 Stainless Steel and provided with yoke as integral part of the rod.
- Shall be provided with a Brass cotter pin to secure the rod to the curb stop ball valve.
- The rod "wrench flat" shall have a minimum thickness of 1/4" tapered to 1/16" and width of 5/8".

2.12 CORPORATION STOPS

- A. All corporation valves shall be of the 1/4 turn ball valve design and meet or exceed the latest revision of ANSI/AWWA Standard C-800.
- B. Corporation stops shall have "CC or AWWA taper" threads on the inlet.
- C. Outlet connections shall be CPPJ. CPPJ corporations shall be designed such that the PJ nut "shoulders" tight against the corporation valve body. PJ connections utilizing setscrews are not permitted.
- D. The corporation body and components shall be of heavy brass construction of 85-5-5 ASTM B62 brass for strength and durability. The ball mechanism shall be constructed of Teflon coated brass and provide a full port opening.
- E. The valve stem shall be provided with double Buna-N o-rings to insure a permanent watertight seal. The ball seats shall also be molded Buna-N rubber.
- F. Rated working pressure shall be 250-psig minimum.

2.13 COPPER SERVICE LINE TUBING AND PIPING

- A. Type "K" copper tubing will be used for service lines and shall meet or exceed the latest revision of AWWA standard C-800.
- B. Underground service line malleable tubing shall be seamless Type "K" copper exclusively and conform to ASTM Standard B-88.
- C. All fittings shall be 2" copper with compression joints. Conforming to applicable AWWA standards.

2.14 CURB STOPS

- A. All curb stop valves shall be of the 1/4 turn ball valve design and meet or exceed the latest revision of ANSI/AWWA Standard C-800.
- B. Curb stops bodies for sizes 3/4" to 2" shall have full depth F.I.P. thread ends.

- C. Outlet connections shall be CPPJ. CPPJ curb stops shall be designed such that the PJ nut “shoulders” tight against the curb stop valve body. PJ connections utilizing setscrews are not permitted.
- D. The curb stop valve body and components shall be of heavy brass construction of 85-5-5 ASTM B62 brass for strength and durability. The ball mechanism shall be constructed of Teflon coated brass and provide a full port opening.
- E. The valve stem shall be provided with double Buna-N o-rings to insure a permanent watertight seal. The ball seats shall also be molded Buna-N rubber.
- F. The curb stop valve shall **not** have a drain (waste hole).
- G. Rated working pressure shall be 250-psig minimum.

2.15 FIRE HYDRANTS

- A. The District, in an effort to minimize the quantity and diversity of repair parts, maintenance tools, etc. has standardized around the American Darling (B-62-B). Approved equal products may be submitted for review. The hydrant shall be supplied with a 1 5/8” pentagon style top nut, 5 1/4” valve open left, 6” MJ shoe, two 2 1/2” NST and one 4 1/2” NST connection ports. The shoe and lower valve shall be coated inside and out with fusion bonded epoxy paint. The shoe shall be attached to the lower barrel with stainless steel nuts and bolts. All drain ports shall be plugged at the factory.

2.16 THRUST RESTRAINT REQUIREMENTS

- A. Thrust restraint shall be provided on all bends, tees, valves, and dead end ends for pipe diameter sizes 3” and greater. Thrust restraint shall be accomplished utilizing a combination of wedge action retainer glands and concrete bearing thrust blocks wherever thrust forces are an issue. Each component (wedge action retainer glands and concrete thrust blocks) shall be designed to independently restrain the entire thrust force of the specific item to be restrained. Each component shall be designed to withstand a test pressure of **150 pounds per square inch (psi)**. Wedge action retainer glands shall be as specified in the “DUCTILE IRON RESTRAINING GLANDS” section of the materials specifications. Wedge action retainer glands depend on the friction on the skin of the pipe to restrain, therefore it is imperative that a full length of pipe (greater than 16’) enter and exit all fittings and appropriate backfill material thoroughly compacted around the pipe. Some larger diameter fittings and valves may require a longer restrained length than can be obtained from a single full length of pipe, therefore, subsequent push-on joints will need to be restrained as directed by the District or its inspector. Concrete bearing thrust blocks shall be designed as to the amount of bearing area required to restrain the resultant thrust force of the fitting. Soil bearing strength for design purposes shall be 1500 lbs/sq.ft. Unless otherwise specified by a soils engineer. Pounds of Thrust on fittings can be found in the table below. Concrete bearing thrust blocks must be cast against undisturbed soil. If casting against undisturbed soil is not possible than backfill material behind thrust block shall be crushed stone or well-graded gravel compacted to a minimum 95% modified proctor density. Cast-in-place concrete thrust blocks shall be formed up to obtain the

appropriate bearing area prior to pouring concrete. **Under no circumstances shall concrete be cast around (encase) mechanical joint glands or bolts.** The use of an approved pre-cast concrete thrust blocks of appropriate design shall be an acceptable alternative to cast-in-place. The use of gravity concrete thrust blocks will be evaluated on a case-by-case basis and must be pre-approved by the District.

**Resultant Thrust At Fittings
 At 100 psi Water Pressure**

Total Pounds					
Nom. Pipe Dia. (in.)	Dead End	90 Degree Bend	45 Degree Bend	22½ Degree Bend	11 ¼” Degree Bend
3”	1,232	1,742	943	481	241
4”	1,810	2,559	1,385	706	355
6”	3,739	5,288	2,862	1,459	733
8”	6,433	9,097	4,923	2,510	1,261
10”	9,677	13,685	7,406	3,776	1,897
12”	13,685	19,353	10,474	5,340	2,683
16”	23,779	33,628	18,199	9,278	4,661
20”	36,664	51,822	28,046	14,298	7,183
24”	52,279	73,934	40,013	20,398	10,249

Notes:

To determine thrust at pressures other than 100 psi multiply the thrust obtained in the table by the ratio of the pressure to 100.

Thrust on a tee is the same as thrust on a “Dead End”.

2.17 RIGID INSULATION

- A. Installation, when required by the Drawings, shall be Styrofoam SM or TG as manufactured by the Dow Chemical Company or equal.

Materials submitted shall have a K factor of .20 @ 75 degrees by ASTM C518-70, 2-lb. density by ASTM C303-56, compressive strength of 30-lb. by ASTM D1621-64 and a water absorption of less than .05 meet Federal Specifications HH1524B Type II, Class B.

2.18 TEMPORARY WATER SERVICES

- A. Temporary Water Service: Provide temporary water service as necessary during the site work and building construction. Use materials as approved by the Portland Water District.

PART 3 - EXECUTION

3.1 WATER DISTRIBUTION SYSTEM

- A. Building Service Lines: Install water service lines to point of connection within approximately five feet outside of buildings to which such service is to be connected and make connections thereto. If building services have not been installed provide temporary caps. Connections of service lines to distribution mains shall be constructed in accordance with the following requirements.
1. 2 Inch and Larger: Connect by rigid connections and provide gate valve below frost line.
- B. Regrading: Raise or lower existing valve and curb stop boxes and fire hydrants to finish grade in areas being graded.
- C. Pipe Laying, General
1. Install to same tolerances as specified for storm drain (Section 02720).
 2. Do not lay pipe on unstable material, in wet trench, or, when trench or weather conditions are unsuitable.
 3. Support pipe laid in fill area at each joint, by brick or concrete piers carried down to solid undisturbed earth.
 4. Do not lay pipe in same trench with other pipes or utilities.
 5. Hold pipe securely in place while joint is being made.
 6. At least one foot shall separate water lines vertically from other pipes or underground structures.
 7. Where water pipes cross sanitary sewers or are laid parallel and adjacent to them, bottom of water pipe shall be separated by not less than one foot above top of sewer and ten feet horizontally.
 8. Do not work over, walk on, pipes in trenches until covered by layers of earth well tamped in place to a depth of 12 inches over pipe.
 9. Full length of each section of pipe shall rest solidly upon pipe bed with recesses excavated to accommodate bells or joints. Do not lay pipes on wood blocking.
 10. Install water lines to avoid storm and sanitary sewer lines.
 11. Clean interior of pipe thoroughly of all foreign matter before installation. Keep pipes clean during laying operations by means of plugs or other methods. When work is not in progress, securely close open ends of pipe and fittings to prevent water, earth, or other substances from entering.
 12. Tees, plugs, caps, bends and hydrants on pipe installed underground shall be anchored. Pipe clamps and tie rods, or concrete thrust blocks may be used. Type of pipe and soil conditions determines methods. Anchor water mains as specified in NFPA No. 24.
 13. Close pipe openings with caps or plugs during installation. Tightly cover and protect equipment against dirt, water and chemical, or mechanical injury. At completion of all work thoroughly clean exposed materials and equipment.

D. Construction Practice for Polyethylene Pipe

1. Trench Construction: Trenching should be done in accordance with ASTM D2321, Section 6 and/or ASTM D 2774.
2. Embedment Material: Embedment materials should be Class I, Class II, or Class III materials as defined by ASTM D 2321, Section 5. The use of Class IV and Class V materials for embedment is not recommended and should be done only with the approval of the engineer. Class I crushed stone and Class II well-graded gravels are preferred. The embedment material shall have an installed density of at least 85% Standard Proctor Density through compaction or consolidation.
3. Bedding: The pipe bedding should be constructed in accordance with ASTM D 2321, Section 5, Table 2.
4. Haunching and Initial Backfill: Haunching and initial backfill should be as specified in ASTM D 2774 and/or ASTM D2321, Section 5, Table 2 using Class I, Class II, or Class III materials. Materials and compaction shall be specified by the engineer. In cases where a compaction of 85% Standard Proctor Density is not attainable, the engineer may wish to increase the DR of the pipe to provide a stable pipe/soil system.
5. Special Conditions: ASTM D 2321, Section 6.4.3, *Removal of Trench Wall Support*, Section 7.5, *Placing and Compacting Pipe Embedment*, and Section 7.6, *Minimum Cover* should apply unless directed otherwise by the engineer.
6. Testing: Gravity flow pipelines shall be tested to the requirements and specifications of the engineer of record. HDPE pressure pipe shall be tested in accordance with the specifications and requirements of the engineer of record and/or with the manufacturer's recommendations. The pressure rating of the pipe is a function of temperature at the time of hydro-test. Refer to the manufacturer's temperature related pressure ratings. Hydro-test the piping system at 1.5 times the pressure rating of the pipe for 2 to 3 hours per Driscopipe Technical Note #35. If a system component such as a fabricated or mechanical fitting has a pressure rating less than that of the pipe, the piping system should be pressure tested to manufacturer's guidelines on that component.

E. Joining of Polyethylene Pipe:

1. Sections of polyethylene pipe shall be joined by the butt fusion process into continuous lengths at the job site. The joining method shall be the heat fusion method and shall be performed in strict accordance with the pipe manufacturer's recommendations. The heat fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.
2. Properly executed electrofusion fittings may be used. Extrusion welding or hot gas welding of HDPE shall not be used for pressure pipe applications or fabrications where shear or structural strength is important. Mechanical joint adapters, flanges, unions, grooved-couplers, transition fittings, and some mechanical couplings may be used to mechanically connect HDPE pipe with fittings approved for this use as specified in other portions of this specification.
3. CTS joints may be used in lieu of butt fusion upon approval of the Owner, the Water District, and the Engineer.

F. Laying Ductile Iron Pipe:

1. Lay pipe in accordance with AWWA C600.

2. Push-on pipe shall be assembled in strict accordance with the manufacturer's instructions as described below.
 - a. Thoroughly clean the groove and bell socket and insert the gasket, making sure that it is correctly seated.
 - b. After cleaning dirt or foreign material from the plain end, apply lubricant in accordance with the pipe manufacturer's recommendations. The lubricant is supplied in sterile cans and every effort shall be made to keep it sterile.
 - c. Be sure that the plain end is beveled; square or sharp edges may damage or dislodge the gasket and cause a leak. When pipe is cut in the field, bevel the plain end with a heavy file, grinder or pipe saw to remove all sharp edges. Push the plain end into the bell of the pipe. Keep the joint straight while pushing. Make deflection after the joint is assembled.
 - d. Small pipe can be pushed into the bell socket with a long bar. Large pipe (generally 12" diameter or greater) require additional power, such as a pipe jack, lever puller or backhoe. The pipe supplier may provide a pipe jack or lever puller on a rental basis. A Timber header should be used between the pipe and jack or backhoe bucket to avoid damage to the pipe.
3. Mechanical Joint Pipe shall be assembled in strict accordance with manufacturer's instructions as described below:
 - a. Wipe clean the socket and the plain end. The plain end, socket, and gasket shall be washed with a soap solution to improve gasket seating. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.
 - b. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly. Make deflection after joint assembly but before tightening bolts.
 - c. Push the gland toward the socket and center it around the pipe with the gland lip against the gasket. Insert bolts and hand-tighten nuts.
 - d. Tighten the bolts to the normal range of bolt Torque (75-90 ft-lbs for 4" to 24" diameter pipe) while at all times maintaining approximately the same distance between the gland and the face of the flange at all points around the socket. This can be accomplished by partially tightening the bottom bolt first, then the top bolt, next the bolts at either side, finally the remaining bolts. Repeat the process until all bolts are within the appropriate range of torque. Generally 3 to 4 repetitions are required.
4. For other types of pipe joints that may be specified for "specialty" type jobs, specific instructions will be given as needed.
5. Pipe cleanliness. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. No debris, tools, clothing, or other material (or people) shall be placed in the pipe at any time.
6. Pipe placement. As each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade. The pipe shall be brought to grade with stone.
7. Direction of the bells. It is common practice to lay the pipe with the bells facing the direction in which work is progressing

8. Temporary pipe plugs. At times when work is not in progress, the open end of the pipe shall be closed by means of a watertight plug or other means acceptable to the District. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe floatation should the trench fill with water.
9. Pipe deflection. When it is necessary to deflect pipe from a straight line either the horizontal or vertical plane, the amount of deflection shall not exceed 75% of the maximum allowable deflection as specified by the manufacturer. For example, for 12” CLDI push-on pipe, the maximum allowable deflection is 5 degrees or 21” for a 20’ length of pipe. Therefore, the District will permit 75% of 21” or 15” maximum deflection per joint. Please keep in mind that deflections are cumulative in the horizontal and vertical plane.
10. Polyethylene Encasement. Polyethene encasement of CLDI water mains shall be done when specifically specified.

G. Setting of Ductile Iron Fittings:

1. All fittings shall be inspected prior to installation to ensure the gasket seats are free of excess coating. Excess coating, if present, shall be manually removed so as to ensure proper seal of gasket, however all bare metallic surfaces created as the result of removing the excess coating shall be recoated with similar material to prohibit corrosion.
2. The District prefers the use of “compact fittings” as specified in 1.1 above for all fittings 3” to 16”. The Contractor shall seek prior approval for the use of “standard” size fittings in the 3” to 16” range.
3. Fittings shall be placed, supported and installed in strict accordance with the manufacturer’s instructions and as directed by the District. All bolted joints shall be torqued as follows:

Mechanical Joint 4” to 20” diameter pipe.

¾” bolts; Torque 75 to 90 ft-lbs.

Flanged Joint 4” to 24” diameter pipe.

5/8” bolts; Torque 40 to 60 ft-lbs

¾” bolts; Torque 60 to 90 ft-lbs

7/8” bolts; Torque 70 to 100 ft-lbs

1” bolts; Torque 70 to 100 ft-lbs

1 ¼” bolts; Torque 90 to 100 ft-lbs

4. After bolts are inserted and made finger tight, tighten diametrically opposite nuts progressively and uniformly around joint with properly calibrated torque wrench to the values as specified.
5. Coat all bolt threads for flanged connections with never-seize or an approved equal product.

H. Setting of Ductile Iron Restraining Glands:

1. All joint restraining devices shall be installed in strict adherence to the manufacturer’s instructions. Torque wrenches **must** be used in the tightening of setscrews and flange bolts in **all** cases.

2. The Contractor shall thoroughly inspect all joint restraining devices for stress cracks and similar physical defects or damage prior to their installation.
- I. Setting of Ductile Iron Couplings (Sleeves):
1. Couplings shall be installed in strict accordance with the manufacturer's instructions. All nuts shall be tightened in an alternating star pattern with a properly calibrated torque wrench as specified.
 2. Off-set marks shall be made on coupling pipe at all times to allow for the coupling to be centered over the joint between the two sections of main being coupled.
 3. A minimum of two linear field ties shall be taken by the Contractor so as to provide an accurate location of the coupling(s) once buried.
- J. Setting of Three Part Couplings:
1. A minimum of 2 lateral "ties" shall be taken from permanent fixtures such as house corners, telephone poles, fire hydrants, etc. to the coupling for purposes of future location. These ties shall be recorded in sketch form and submitted to the District prior to final acceptance.
 2. Acceptable manufacturers are Ford (FB1000) and Muller (300 B-25008) or pre-approved equal products.
- K. Setting of Insertion Valves:
1. During installation, water service must be maintained at all times. No disruption of service will be allowed.
 2. All joint bolts shall be torqued using a calibrated torque wrench in accordance with manufacturer's specifications.
 3. Great care shall be taken to ensure that no damage occurs to the unit prior to installation.
 4. All valves shall be installed in accordance with the manufacturer's recommendations and installed by a technician trained by the manufacturer.
 5. The District will review at no charge submittals of "other" valve manufacturers that the Contractor may desire to use, however, **no** valve substitutions are permitted without prior written approval by the District.
- L. Setting of Resilient Seat Wedge Gate Valves:
1. During installation, the valve body shall **not** be set on wooden blocking, the supporting material will be crushed stone.
 2. All joint bolts shall be torqued using a calibrated torque wrench in accordance with manufacturer's specifications.
 3. Great care shall be taken to ensure that the fusion-bonded epoxy coated exterior is not damaged. Any damaged areas shall be repaired by the Contractor in accordance with the manufacturer's recommendation at the sole expense of the contractor.
 4. All valves shall be restrained by means of threaded rods to the nearest fitting if length is less than 10'. If the length is more than 10' use a restraining gland as per the section "Ductile Iron Restraining Glands". The rods used shall be stainless steel or A36 carbon steel coated with a bituminous coating. The size and location of the rods will be approved by the District prior to installation.

5. The District will review at no charge submittals of “other” valve manufacturers that the Contractor may desire to use, however, **no** valve substitutions are permitted without prior written approval by the District.

M. Setting of Valve Boxes:

1. Valve boxes shall be installed concentric to the operating nut and plumb with the vertical plane. The belled base section shall be placed on blocking in such a way that no additional loading is transferred to the valve.
2. Longer valve box bottoms and/or tops will be specified as required for water mains at depths that exceed the limitations of the above specified valve box.
3. A minimum of 2 lateral “ties” shall be taken from permanent fixtures such as house corners, telephone poles, fire hydrants, etc. to the valve box for purposes of future location. These ties shall be recorded in sketch form and submitted to the District prior to final acceptance.

N. Setting of Service Boxes:

1. Service box bases shall be placed on the same blocking that supports the curb stop ball valve and set plumb with the vertical plane in all directions.
2. Service box tops shall be set 1” to 2” below finish grade, magnetized and painted fluorescent blue (standard water works color) prior to burial.
3. A minimum of 2 lateral “ties” shall be taken from permanent fixtures such as house corners, telephone poles, fire hydrants, etc. to the coupling for purposes of future location. These ties shall be recorded in sketch form and submitted to the District prior to final acceptance.

O. Setting of Corporation Stops:

1. The District only permits ¾” & 1” diameter direct tapped corporations into Cast Iron and Ductile Iron mains. Larger Direct tapped corporations will be evaluated on an individual case basis.
2. Corporation taps shall be located at 10:00 or 2:00 o’clock on the main.
3. Corporations shall be “screwed” into Ductile Iron pipe watermains such that no more than 4 threads are exposed.
4. A minimum of 2 lateral “ties” shall be taken from permanent fixtures such as house corners, telephone poles, fire hydrants, etc. to the corporation for purposes of future location. These ties shall be recorded in sketch form and submitted to the District prior to final acceptance.
5. Acceptable manufacturers are Ford (FB1000) and Muller (300 B-25008) or pre-approved equal products.

P. Setting of Copper Service Line Tubing:

1. Extreme care shall be taken during installation to ensure that copper tubing is not crimped, gouged or otherwise detrimentally damaged.
2. The Contractor shall minimize the use of couplings by using the longest continuous coils available for the specific job unless otherwise approved by the District.

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3. Soldering of underground copper tubing joints is **not** permitted. Compression style couplings shall be used.
4. Copper tubing ends shall be de-burred and re-rounded prior to installing fittings to ensure strong, watertight connections.
5. Bedding material shall be preferably sand. Gravel with maximum 1” nominal diameter stones shall also be permitted.
6. The District will size all service lines.

Q. Setting of Curb Stops:

1. Curb stop ball valves shall be firmly supported on a 1” thick x 2”x2” cement block, set plumb and positioned such that the operator key is in the vertical plane prior to backfilling.
2. All curb stop ball valves shall be provided with service boxes (see Service Box specification) unless otherwise specified by the District.
3. Prior to backfilling, the curb stop ball valve shall be placed under a static head pressure test unless otherwise waived by the District.
4. A minimum of 2 lateral “ties” shall be taken from permanent fixtures such as house corners, telephone poles, fire hydrants, etc. to the Curb Stop for purposes of future location. These ties shall be recorded in sketch form and submitted to the District prior to final acceptance.
5. Acceptable manufacturers are Ford (FB1000) and Muller (300 B-25008) or pre-approved equal products.

R. Setting of Fire Hydrants

1. All hydrants shall be installed in accordance with the attached standard detail unless otherwise specified. Hydrants shall be installed plumb and true in the vertical plane in all directions.
2. Color code painting of the hydrant shall be done by the District once the installation is complete.

S. Pipe Sleeves: Install where water lines pass through retaining and foundation walls. Properly secure in place, with approximately 1/4-inch space between pipe and enclosing sleeve, before concrete is poured. Caulk annular opening between pipe and sleeves, and seal with asphaltic compound consisting of bituminous materials mixed with mineral matter. Install piping so that no joint occurs within a sleeve. Split sleeves may be installed where existing lines pass through new construction.

T. Meter: The Division 15 Contractor will obtain the meter from the Portland Water District and install the domestic water meter for the installation and will pay all usage charges connected with water supply until the installation is accepted by the Owner.

PART 4 – FLUSHING, PRESSURE TESTING AND DISINFECTION OF WATERMAINS

A. All watermains will be flushed, pressure tested and disinfected prior to final acceptance.

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- B. 48-hour notification will be given prior to any flushing, pressure testing, or disinfection activities.
- C. Testing and disinfection will be done only by an individual with qualifications in this process.
- D. The contractor shall provide all necessary materials and equipment to carry out these activities.
- E. After the installation of the watermain the line will be filled slowly with water from the lowest point to the highest point. This will remove most of the air, flushing the main will remove most of what is left.
- F. The water main will then be tested at 150 psi and maintained at +/- 5 psi for a period of not less than 2 hrs. This shall be done in accordance with the latest revision of AWWA C-600 standard. The allowable leakage shall not be more than the following:

- 12" pipe allowable leakage is 1.1 gph per 1000 feet of pipe at 150 psi.
- 10" pipe allowable leakage is 0.92 gph per 1000 feet of pipe at 150 psi.
- 8" pipe allowable leakage is 0.74 gph per 1000 feet of pipe at 150 psi.
- 6" pipe allowable leakage is 0.55 gph per 1000 feet of pipe at 150 psi.

If the test fails the Contractor shall make the necessary repairs and then retest until a successful test is obtained.

- G. The testing will be to all hydrant valves and to all ends of the watermain.
- H. Prior to disinfection the main will be thoroughly flushed to remove any foreign material that may have gotten into the pipe during installation. Minimum flushing velocities will be 2.5 ft/sec.
- I. A service tap for disinfection purposes will need to be installed at a point closest to the valve feeding the water. A ¾" piece of copper will need to be installed with a curb stop for pumping in the chlorine solution.
- J. Continuous feed method of disinfection is preferred by the District. This is accomplished by flowing the watermain at a predetermined rate and feeding the chlorine solution at a rate to achieve a uniform chlorine level in the watermain. The chlorine level shall be 50 mg/l and shall not exceed 100 mg/l.

The chlorine solution will remain in the main for at least 24 hours. At the end of this time chlorine concentrations shall be at least 25 mg/l.

- K. The slug method can be used however it may be less effective due to less contact time. The strength shall be at a minimum of 300 mg/l and remain in the pipe for at least 3 hours.
- L. After the time has expired for disinfection the watermain will be flushed of the heavily chlorinated water, this will be done until the chlorine is at a level normal to the water system at this point.

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- M. The final step is obtaining a sample to check for bacteria. A sample shall be taken from the main at the point of flushing with water running through the entire new section of pipe. This sample shall show no presence of Coliform bacteria.

If this test fails then the Contractor will re-flush, re-chlorinate and re-test. This will be done until the sample passes the testing.

The first test will be paid by the owner; subsequent testing expenses will be borne by the Contractor.

- N. All materials used for testing and air release purposes will be removed including the corporations and plug the main at the Contractors expense. The Contractor will then provide the District with a set of swing ties to the corporations for future purposes.

END OF SECTION 331100

Table 1
Allowable Leakage for Mechanical-Joint or Push-On Joint Pipe in 18-ft. Nominal Lengths*

Avg. Test Pressure (psi)	Pipe Size - inches															
	2	3	4	6	8	10	12	14	16	18	20	24	30	36	42	48
	Allowable Leakage per 1,000 ft-gph															
250	0.48	0.71	0.95	1.42	1.90	2.38	2.85	3.33	3.80	4.28	4.75	5.70	7.13	8.55	9.98	11.40
225	0.45	0.68	0.90	1.35	1.80	2.25	2.70	3.15	3.60	4.05	4.50	5.40	6.76	8.11	9.46	10.81
200	0.42	0.64	0.85	1.27	1.70	2.12	2.55	2.97	3.40	3.82	4.25	5.10	6.37	7.61	8.92	10.19
175	0.40	0.60	0.79	1.19	1.59	1.99	2.38	2.78	3.18	3.58	3.97	4.77	5.96	7.15	8.34	9.54
150	0.37	0.55	0.74	1.10	1.47	1.84	2.20	2.58	2.94	3.31	3.68	4.41	5.52	6.62	7.72	8.83
140	0.36	0.53	0.71	1.07	1.42	1.78	2.13	2.49	2.84	3.20	3.55	4.26	5.33	6.40	7.46	8.53
130	0.35	0.51	0.69	1.03	1.37	1.71	2.06	2.40	2.74	3.08	3.42	4.11	5.14	6.16	7.19	8.22
120	0.33	0.49	0.66	0.99	1.32	1.64	1.98	2.30	2.63	2.96	3.29	3.95	4.93	5.92	6.91	7.89
110	0.31	0.47	0.63	0.94	1.26	1.58	1.89	2.21	2.52	2.83	3.15	3.78	4.72	5.67	6.61	7.56
100	0.30	0.45	0.60	0.90	1.20	1.50	1.80	2.10	2.40	2.70	3.00	3.60	4.50	5.40	6.31	7.21
90	0.28	0.43	0.57	0.86	1.14	1.42	1.71	1.99	2.28	2.56	2.85	3.42	4.27	5.13	5.98	6.84
80	0.27	0.40	0.54	0.80	1.08	1.34	1.61	1.88	2.15	2.42	2.69	3.22	4.03	4.84	5.64	6.45
70	0.25	0.38	0.50	0.75	1.00	1.26	1.51	1.76	2.01	2.26	2.51	3.01	3.77	4.52	5.28	6.03
60	0.23	0.35	0.46	0.70	0.93	1.16	1.39	1.63	1.86	2.09	2.32	2.79	3.49	4.19	4.89	5.58
50	0.21	0.32	0.42	0.64	0.85	1.06	1.28	1.49	1.70	1.91	2.12	2.55	3.19	3.82	4.46	5.10
40	0.19	0.28	0.38	0.57	0.76	0.95	1.14	1.33	1.52	1.71	1.90	2.28	2.85	3.42	3.99	4.56

* The allowable leakage for a pipeline is calculated by multiplying the leakage per hour per 1,000 feet at the average test pressure and for the diameter of pipe tested as obtained from the above table by the duration of the test in hours and the total length of the line being tested divided by 1,000. If the line under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

SECTION 333100 - SANITARY SEWER COLLECTION/CONVEYANCE SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Furnish labor, materials, services, equipment, and other necessary items required for accompanying the construction of the sanitary systems. This shall include, but not be limited to, the following:

Sanitary sewer drainage piping, Fitting and Accessories, Cleanouts, and Bedding.

Set lines, elevations, and grades for sanitary sewer system work and control system for duration of work, including careful maintenance of benchmarks, property corners, monuments, or other reference points.

Provide sanitary sewer systems for wastewater only. Do not connect foundation drains, roof leaders, or other “illicit sources”.

- B. Related Sections:

1. Section 330500 – Common Work Results for Utilities
2. Construction Drawings.
3. Local governing authority and code requirements.
4. All necessary construction permits.
5. All materials, installation, and workmanship will comply with the requirements specified in this section, the requirements of the Maine State Plumbing Code or the Portland Utility District. Where a more stringent standard exists, the more stringent standard shall apply.

1.2 SUBMITTALS

- A. Product Data: Provide catalog materials indicating pipe, pipe accessories, and fittings.
- B. Manufacturer's Installation Instructions: Indicate special procedures required to install products specified.
- C. Manufacturer's Certificate: Certify that products meet or exceed ASTM designations.

1.3 QUALITY ASSURANCE

- A. ANSI/ASTM A74 - Cast Iron Soil Pipe and Fittings.

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- B. ANSI/ASTM C14 - Concrete Sewer, Storm Drain, and Culvert Pipe.
- C. ANSI/ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
- D. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb. (2.49 kg) Rammer and 12 inch (304.8 mm) Drop.
- E. ANSI/ASTM D3034 - Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
- F. ASTM A746 - Ductile Iron Gravity Sewer Pipe.
- G. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- H. ASTM D1785 - Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
- I. ASTM D2922 - Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
- J. ASTM D3017 - Test Methods for Moisture Content of Soil and Soil-Aggregate Mixtures.

1.4 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.5 COORDINATION

- A. Coordinate the work with termination of the sanitary sewer connection outside building, connection to municipal sewer utility service, and trenching.

PART 2 - PRODUCTS

2.1 NON-METALLIC CASING SPACER & END SEAL FOR WATER CARRIER PIPE

- A. Casing Spacers: Upon completion of the carrier pipe encasement, the contractor shall furnish and install a Ranger II® boltless casing spacer on the carrier pipe as described below:
 - 1. Casing spacers shall be spaced a maximum of eight (8) feet apart along the length of the carrier pipe with one casing spacer within two (2) feet of each side of a pipe joint and the rest evenly spaced. Wood skids are not an acceptable method of supporting the carrier pipe.
 - a. Casing spacers shall be all non-metallic (polypropylene), molded in segments for field assembly without any special tools. Spacer segments shall be secured around carrier pipe by insertion of a Slide-Lock. The casing spacer polymer shall contain ultraviolet inhibitors and shall have a minimum compressive strength of 3,000 psi, an 800 Volts/mil dielectric strength and impact strength of 15. ft-lbs./inch. Each casing spacer shall have full length, integrally molded skids extending beyond the bell or mechanical joint of the carrier pipe.

- b. The casing spacers shall be the PSI Ranger II® Casing Spacers as manufactured by Pipeline Seal and Insulator, Inc., Houston, Texas.
- c. Casing spacers must accommodate the number of pipes shown on the drawings.
- d. Material specifications:

SPECIFICATION	VALUE
Material	UV Resistant Polypropylene
Compressive Strength	3,000 psi (211 kg/cm ²)
Temperature	-22 to +212° F. (-30 to +100° C.)
Impact Strength	1.5 ft. lb./in. 0.8 joules/cm
Dielectric Strength	800 volts/mil. Min.
Color	Black

2.2 GRAVITY SEWER PIPE

- A. Pipe shall be furnished and installed at locations shown on the plans, and to the line and grade indicated on the plans. All piping shall be complete, including fittings, connections to existing structures, and other miscellaneous items of work
- B. Pipe shall be SDR-35 PVC pipe, of the sizes shown on the plans shall be manufactured by Johns-Manville or CertainTeed Products Corp. or approved equal.
- C. Pipe shall conform to ASTM D-3034 for sizes 4” – 15” and ASTM F-679 for sizes 18” – 27” with dimension ratio of SDR-35. PVC resin compound shall conform to ASTM D-1784.
- D. Standard pipe laying lengths shall be 13 ft.
- E. No saddles are permitted on this project. The Contractor will take care in locating new sewer service saddles.
- F. The pipe shall be colored green to identify it for sewer applications.
- G. Fittings will be PVC Gravity Sewer Fittings and meet the requirements and intent of the National Standards ASTM D-3034 for materials and ASTM D-3212 for joints. Contractor shall furnish and install all fittings as required in the pipelines. These will be used for service connections.
- H. All joints PVC pipe shall be gasketed in accordance with ASTM D-3212 and ASTM F-477 and other industry standards and will be “push-on”. Joints will be made using gasketed couplings and bells provided by the pipe manufacturer, and installed in accordance with the pipe manufacturer’s published recommendations.
- I. No glued joints will be allowed in any form. Any joint, which is not properly made, shows signs of leakage, or is any way defective, shall be remade to the satisfaction of the District.

- J. Pipe will be furnished with Gaskets pre installed and lubricants as standard accessories.

2.3 SEWER SERVICE PIPE

- A. Sewer service pipe shall be furnished and installed as required. Connections shall be complete including excavation and backfill, pipe, fittings, connections and other miscellaneous items of work. The service pipe will be tested as per the sewer main testing section prior to connection of any building sewer service to the pipe.
- B. Pipe shall be 4-inches in diameter SDR-35 PVC pipe, as manufactured by Johns-Manville or CertainTeed Products Corp. or approved equal.
- C. Pipe shall conform to ASTM D-3034 with dimension ratio of SDR-35. PVC resin compound shall conform to ASTM D-1784.
- D. Standard pipe laying length shall be 13 ft.
- E. The pipe shall be colored green to identify it for sewer applications.
- F. Fittings will be PVC Gravity Sewer fittings and meet the requirements and intent of the National Standards ASTM D-3034 for materials and ASTM D-3212 for joints. All elbows used for service connections shall be bends or sweeps.
- G. All joints PVC pipe shall be gasketed in accordance with ASTM D-3212 and ASTM F-477 and other industry standards and will be “push-on”. Joints will be made using gasketed couplings and bells provided by the pipe manufacturer, and installed in accordance with the pipe manufacturer’s published recommendations.
- H. No glued joints will be allowed in any form. Any joint, which is not properly made, shows signs of leakage, or is any way defective, shall be remade to the satisfaction of the District.
- I. Pipe will be furnished with Gaskets pre installed and lubricants as standard accessories.
- J. Connections to existing service pipe not compatible with a gasketed joint will be made with a flexible coupling with stainless steel band, housing and screw.

2.4 FLEXIBLE COUPLINGS

- A. This work shall consist of furnishing of and installing all flexible couplings specified herein.
- B. Flexible couplings shall be Elastomeric Polyvinyl Chloride Couplings, as manufactured by Fernco Inc., of Davidson, MI or approved equal.
- C. Flexible couplings must comply with applicable parts of ASTM #C443, C425, C564, and D1869.
- D. Flexible couplings shall have series 300 stainless steel clamps both ends. All parts of the clamp are to be Series 300 stainless steel including the band, housing and screw.

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- E. Flexible couplings shall be of correct size and configuration for the application. The couplings will be specifically manufactured for the sizes and types of piping to be connected and clearly labeled on the coupling.
- F. The manufacturer shall provide standard installation instructions with the flexible couplings.

2.5 CLEANOUTS

- A. Lid and Frame: Heavy duty cast iron construction, manufactured by Mueller: Lid Design: (Refer to Section 33 39 00).
- B. Shaft Construction: Cast iron shaft of internal diameter as specified on plans with 2,500 psi concrete collar for cleanouts located in paved areas.
- C. Base Pad: Cast-in-place concrete, 2,500 psi leveled top surface to receive cast iron shaft sections, sleeved to receive sanitary sewer pipe sections.

2.6 PIPE AND VALVING ASSOCIATED WITH STRUCTURES

- A. All pipe and valving shall be cast/ductile iron with 125 lb ANSI standard flanges.
- B. All pipe to be cement lined.
- C. Air and vacuum valve (if required) shall be Crispir Model A141.
- D. Paint any piping inside special appurtenances with epoxy paint in accordance with 10 state standards and/or TR-16 manual "Guides for the Design of Wastewater Treatment Works."

PART 3 - EXECUTION

3.1 INSTALLATION – NON-METALLIC CASING SPACER & END SEAL FOR WATER CARRIER PIPE

- A. The carrier spacing installation shall be in accordance with the manufacturers instructions and witnessed by the owner.

3.2 INSTALLATION - GRAVITY SEWER PIPE

- A. Each pipe and fitting shall be inspected prior to installation to insure: the gasket is properly adhered to the bell of the pipe, the pipe is straight within 1/16" end to end, the pipe is of proper shape within 5% of round, cracks or any other damage. If a pipe is found to not pass the inspection the pipe will immediately be removed from the site.
- B. Pipe shall be assembled in strict accordance with the manufacturer's instructions as described below:

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1. Thoroughly clean the groove and bell socket and the gasket, make sure that gasket is correctly seated.
 2. After cleaning dirt or foreign material from the plain end, apply lubricant in accordance with the pipe manufacturer's recommendations. The lubricant is supplied in sterile cans and every effort shall be made to keep it sterile.
 3. Be sure that the plain end is beveled; square or sharp edges may damage or dislodge the gasket and cause a leak. When pipe is cut in the field, bevel the plain end with a heavy file, grinder or pipe saw to remove all sharp edges. Push the plain end into the bell of the pipe. Keep the joint straight while pushing.
 4. Most sizes of pipe can be pushed into the bell socket with a long bar. Large pipe may require additional power, such as a pipe jack, or lever puller. The pipe supplier may provide a pipe jack or lever puller on a rental basis. A Timber header should be used between the pipe and jack to avoid damage to the pipe.
- C. Excavations shall be made to a point at least 6-inches below the pipe to accommodate the ¾" crushed stone bedding material. This material is to extend from 6" below the pipe to 6" above the pipe.
- D. All excavations are to be kept dry while pipe is being installed and until each joint and pipe has been observed by the Engineer, and approval given to commence backfilling operations.
- E. Pipe shall be laid in strict accordance with the pipe manufacturer's published recommendations. Any pipe, which is not installed to grade and alignment, shall be reinstalled to the satisfaction of the Engineer.
- F. Foreign material shall be prevented from entering the pipe during installation. No debris tools clothing or other material will be placed in the pipe at any time.
- G. Temporary pipe plugs shall be used at all times when work is in progress, the open end of the pipe shall be closed at all times by means of a water tight plug or other means acceptable to the Engineer. When practical the plug shall remain in the place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.
- H. The centerline of the pipe will not deviate more than 1/16" from the line between the two manholes it is being installed on.
- I. The pipe shall not deviate more than .02' vertically from the designed grade in the total pipe run from manhole to manhole.
- J. If the contractor over excavates the pipe will be brought to grade with crushed stone no other material will be allowed under the pipe.
- K. No pipe installation will be allowed to begin at any point other than a manhole or other appurtenance without the expressed consent of the Engineer.
- L. Testing will be done in accordance with the Contract Documents.
- M. Chimneys shall be located where directed by the District, and constructed in accordance with the details shown on the plans. Concrete encasement shall be 3,000-pound class. Ends of the chimney shall be capped with standard caps.

3.3 INSTALLATION – SEWER SERVICE PIPE

- A. Each pipe and fitting shall be inspected prior to installation to insure: the gasket is properly adhered to the bell of the pipe, the pipe is straight within 1/16" end to end, the pipe is of proper shape within 5% of round, cracks or any other damage. If a pipe is found to not pass the inspection the pipe will immediately be removed from the site.
- B. Pipe shall be assembled in strict accordance with the manufacturers instructions as described below:
 - 1. Thoroughly clean the groove and bell socket and the gasket, make sure that gasket is correctly seated.
 - 2. After cleaning dirt or foreign material from the plain end, apply lubricant in accordance with the pipe manufacturer's recommendations. The lubricant is supplied in sterile cans and every effort shall be made to keep it sterile.
 - 3. Be sure that the plain end is beveled; square or sharp edges may damage or dislodge the gasket and cause a leak. When pipe is cut in the field, bevel the plain end with a heavy file, grinder or pipe saw to remove all sharp edges. Push the plain end into the bell of the pipe. Keep the joint straight while pushing.
 - 4. Most sizes of pipe can be pushed into the bell socket with a long bar. Large pipe may require additional power, such as a pipe jack, or lever puller. The pipe supplier may provide a pipe jack or lever puller on a rental basis. A Timber header should be used between the pipe and jack to avoid damage to the pipe.
- C. Excavations shall be made to a point at least 6-inches below the pipe to accommodate the ¾" crushed stone bedding material. This material is to extend from 6" below the pipe to 6" above the pipe.
- D. All excavations are to be kept dry while pipe is being installed and until each joint and pipe has been observed by the Engineer, and approval given to commence backfilling operations.
- E. Pipe shall be laid in strict accordance with the pipe manufacturer's published recommendations. Any pipe, which is not installed to grade and alignment, shall be reinstalled to the satisfaction of the Engineer.
- F. Foreign material shall be prevented from entering the pipe during installation. No debris tools clothing or other material will be placed in the pipe at any time.
- G. Temporary pipe plugs shall be used at all times when work is in progress, the open end of the pipe shall be closed at all times by means of a water tight plug or other means acceptable to the Engineer. When practical the plug shall remain in the place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.
- H. The pipe shall not deviate more than .02' vertically from the designed grade in the total pipe run from manhole to manhole.
- I. If the contractor over excavates the pipe will be brought to grade with crushed stone no other material will be allowed under the pipe.
- J. No pipe installation will be allowed to begin at any point other than a service tee or other appurtenance without the expressed consent of the Engineer.

3.4 INSTALLATION – FLEXIBLE COUPLINGS

- A. The contractor shall install the flexible couplings at the locations indicated on the design plans.
- B. The contractor shall install the flexible couplings to insure a watertight seal at the locations shown on the design plans. The screw torque be as required by the manufacturer.
- C. The contractor shall remove from site any couplings that are damaged prior to or during installation of the flexible couplings.

PART 4 – FIELD QUALITY CONTROL

4.1 TESTING OF SANITARY SEWER SYSTEM (GRAVITY MAIN)

- A. All sewers and force mains throughout the entire length of lines shall be tested for water tightness. Testing shall be by internal pressure tests. All pipes shall pass the following tests prior to final acceptance.
- B. Where groundwater is high the District may elect to accept infiltration measurements in lieu of exfiltration tests.
- C. The Contractor shall furnish, at his own expense, the necessary facilities for making the test including the furnishing and placing of bulkhead, furnishing and placing of water and other necessary materials, labor and equipment.
- D. A section under these specifications shall mean a length of sewer between any two manholes. The force mains shall be tested after the lines are completed.
- E. Internal Pressure Test for Force Mains:
 - 1. All pipe lines shall be tested hydrostatically for 15 minutes at a pressure of 50 percent in excess of the pressures to which the pipe will be normally subjected, unless different test pressures are required by the District by in no case less than 50 pounds per square inch (psi). Any obvious leaks or ruptured piping disclosed by the tests shall be repaired or replaced and the test repeated to the District's satisfaction. See testing of Sewer Force Mains section for details.
- F. Low Pressure Air Test For Gravity Sewers:
 - 1. The contractor shall test the gravity sewers with a low-pressure air test. It shall be conducted in compliance with the following:

After completing back fill of a section of wastewater line, the Contractor shall, at his own expense, conduct a Line Acceptance Test using low-pressure air. The test shall be performed using the below stated equipment, according to stated procedures and under the supervision of the District.

G. Gravity Sewer Test Equipment:

1. Cherne Air-Loc Equipment, as manufactured by Cherne Industrial, Inc. of Edina, Minnesota or approved equal. Equipment used shall meet the following minimum requirements:
 - a. Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be inspected.
 - b. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
 - c. All air used shall pass through a single control panel.
 - d. Three individual hoses shall be used for the following connections:
 - From control panel to pneumatic plugs for infiltration.
 - From control panel to sealed line for introducing the low-pressure air.
 - From sealed line to control panel for continually monitoring the air pressure rise in the sealed line.

4.2 GENERAL LEAKAGE TESTING INSTRUCTIONS

- A. All pneumatic plugs shall be seal tested before being used in the actual test installation. One length of pipe shall be laid on the ground and sealed at both ends with the pneumatic plugs to be checked. Air shall be introduced into the plugs to 25 psig. The plugs shall hold against this pressure without bracing and without movement of the plugs out of the pipe.
- B. After a manhole-to-manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs are checked by the above procedure, the plugs shall be placed in the line at each manhole and inflated to 25 psig. Low-pressure air shall be introduced into this sealed line until the internal air pressure reaches 4 psig greater than the average backpressure of any ground water that may be over the pipe. At least two minutes shall be allowed for the air pressure to stabilize.
- C. After the stabilization period (4.0 psig minimum pressure in the pipe), the air hose from the control panel to the air supply shall be disconnected. The portion of line being tested shall be termed "Acceptable" if the time required in minutes for the pressure to decrease from 4.0 to 3.0 psig (greater than the average back pressure of any ground water that may be over the pipe) shall not be less than the time shown for the given diameters in the following table:

<u>Pipe Dia. In Inches</u>	<u>Minutes</u>
4.....	2.0
6.....	3.0
8.....	4.0
10.....	6.0
12.....	5.5
15.....	7.5
18.....	8.5
21.....	10.0
24.....	11.5

- D. In areas where ground water is known to exist, the Contractor shall install a one-half inch diameter capped pipe nipple approximately 10” long, through the manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately prior to the performance of the Line Acceptance Test, the ground water shall be determined by removing the pipe cap, blowing air through the pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to the nipple. The hose shall be held vertically and a measurement of the height in feet of water over the invert of the pipe shall be taken after the water has stopped rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings. (For example, if the height of water is 11 ½ feet, then the added pressure will be 5 psig. This increases the 4.0 psig to 9.0 psig and the 3.0 psig to 8.0 psig. The allowable drop of one pound and the timing remain the same).
- E. The Contractor shall furnish all labor, materials and equipment for making infiltration and leakage tests.
- F. If the pipe fails to meet any of the test requirements the contractor will at his own expense make the necessary repairs. These repairs must be acceptable to the Engineer.

4.3 PIPE DEFLECTION TEST

- A. Pipe shall be tested for deflection maximum allowable deflection shall be 5.0 percent. This is computed by multiplying the amount of deflection by 100 and dividing by the nominal diameter of the pipe.
- B. The contractor shall wait a minimum of 30 days from the date installation of the section of the sewer. Including placement and backfilling over the installed pipe. Prior to performing the deflection test on the pipe.
- C. This test will be performed by pulling a specially designed gauge tool through the pipe. The tool shall be in accordance with the recommendations of the pipe manufacturer and acceptable to the engineer.
- D. If a section of pipe is found to be out of compliance it will be repaired at the contractor’s expense.

THE ATTENTION OF THE CONTRACTOR IS DIRECTED TO THE STRICT REQUIREMENTS RELATIVE TO MAXIMUM RATES OF THE INFILTRATION AND TO THE IMPORTANCE OF THESE SPECIFICATIONS RELATIVE TO TIGHT JOINTS REQUIRED. SEWERS NOT MEETING THE ABOVE REQUIREMENTS SHALL BE REPAIRED AS NECESSARY AT THE CONTRACTOR’S EXPENSE.

4.4 WARRANTY

- A. All products shall be warranted against failure caused by manufacturing defects for a period of one year. Any product found to be so defective and returned within one year from date of shipment will be replaced without charge. The above warranty is made in lieu of, and we disclaim, any and all other warranties, expressed or implied, including the warranties of merchantability and fitness for a particular purpose, and buyer agrees to accept the products without any such warranties. We hereby disclaim any obligation or liability for consequential damages, labor costs or any other claims or liabilities of any kind whatsoever.

END OF SECTION 333100

SECTION 333900 - APPURTENANCES FOR UTILITIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Monolithic concrete manholes with masonry transition to lid frame, covers, anchorage and accessories.
2. Modular precast concrete manhole sections with tongue-and-groove joints with masonry transition to lid frame, covers, anchorage and accessories.
3. Masonry manholes sections with masonry transition to lid frame, covers, anchorage and accessories.
4. Precast grease traps, and SEWER SYSTEM accessories when required on the contract drawings.
5. Catch basin structures.
6. Water Quality units when required on the contract drawings.
7. Outlet control structures.
8. Flared concrete inlets.
9. Water meter pit if required by the drawings
10. Electrical transformer pads.
11. Electrical handholes if required on the Contract Drawings.
12. Precast bases for lighting

B. Related Sections:

1. Section 312000 – Earthmoving
2. Section 334100 – Storm Utility Drainage Piping
3. Section 333100 – Sanitary Sewer Systems
4. Local Governing Authority and Code Requirements
5. Construction Drawings

1.2 REFERENCES

- A. ANSI/ASTM C55 - Concrete Building Brick.
- B. ASTM A48 - Gray Iron Castings
- C. ASTM C478 - Precast Reinforced Concrete Manhole Sections.
- D. ASTM C923 - Resilient Connectors Between Reinforced Concrete Manhole Structures and Pipes.
- E. ASTM D1248 - Precast Polyethylene Manholes.

- F. International Masonry Industry All-Weather Council (IMIAC): Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.3 SUBMITTALS

- A. Shop Drawings: For all precast structures indicate manhole locations, rim elevation, piping, sizes, and elevations of proposed penetrations. For all other precast appurtenances, provide dimensional data, ASTM compliance certificates, and load capacity where applicable.
- B. Product Data: Provide manhole covers, component construction, features, configuration, and dimensions. Each precast structure shall have a diagram showing the dimensions and location of all openings or penetrations.

PART 2 - PRODUCTS

2.1 PRECAST CONCRETE ITEMS

- A. Precast Manhole and Sections: Manhole and super-structures shall be precast reinforced concrete of the dimensions indicated on the Plans conforming to ASTM Specification C478. Sections shall be installed with a flexible plastic gasket equal to or better than "Ram-Nek" as manufactured by K. T. Snyder Co., Houston, Texas, or sections may be fabricated to accept Tylox "0" rubber gaskets as manufactured by Hamilton Kent Manufacturing Co., Kent, Ohio. The casting and the outside of the brick work required to bring the rim to grade shall be plastered with at least 3/8" mortar, thoroughly troweled to leave a smooth waterproof vertical exterior surface.

Manhole steps shall be forged aluminum safety type, alloy 6061, temper T6, or reinforced polypropylene plastic. Steps shall be cast or anchored into walls of precast sections to form a ladder with a distance of 12 inches between steps.

The Contractor shall furnish the name of the manufacturer to the Engineer prior to commencing work.

All catch basins shall be cast with an opening for a 4-inch underdrain to drain the subgrade as shown on the contract drawings unless the incoming storm drain line is a perforated line.

- B. Precast Manhole Bases: Manhole bases shall be precast reinforced concrete of the dimensions indicated on the Plans conforming to ASTM Specification C478. Bases shall be placed on a well compacted layer of crushed stone.

Jointing system for pipe entering or leaving manholes shall be a flexible manhole sleeve cast in the base. A stainless steel pipe clamp shall be used to fix the pipe into the sleeve. All materials shall meet or exceed rubber quality standards of ASTM C-443 and C-361.

For manhole bases, a minimum of 4 inches shall be allowed between pipe invert and inside bottom of base for construction of brick inverts.

Where precast bases are used for drop manholes, a 6 inch concrete slab is to be placed under the base section large enough to receive the concrete encased drop pipes. Provide suitable ties between manhole sections and drop pipe encasements.

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.

- C. Outlet Control Structure: Provide precast concrete unit, covers, weirs, orifices, and appurtenances as shown on the drawings. Provide information on the method, materials, installation, and quality control measures which will be used to seal the wall between the inlet and outlet side of the manhole.
- D. Precast Tanks, Vaults, and Appurtenances: Precast tanks, vaults, and appurtenances shall be constructed of precast reinforced concrete with inside dimensions conforming to those indicated on the contract drawings and conforming to ASTM C478. The tank may be a monolithic section or constructed with tongue and grooves with approved watertight sealants such as butyl sealant. All penetrations through the tank shall use either cast in place wall sleeves with Link Seals or a flexible boot secured in the casting such as Kor N Seal. Any clamps or metallic connections shall be stainless steel. Any water storage tanks, cisterns, or clear wells shall meet AWWA and NFPA Standards.

The tanks, vaults, and appurtenances shall include shop drawings and submittals with supporting computations which demonstrate the tank can support an H₂O loading, an equivalent external fluid pressure of 105 lb./cubic ft. (with the tank empty), and an internal fluid pressure of 65 lb./cubic ft. The pressures shall be assumed to apply from the base of the structure to the finish grade surface.

Tanks which require attachment to an anti-flotation slab shall use stainless steel angles and anchors sized to resist the uplift force.

The tanks shall be coated with a waterproof seal on the interior and exterior. Sections shall be fabricated to receive a watertight seal.

2.2 CASTINGS

- A. The Contractor shall furnish all cast iron frames, grates, and covers conforming to the details shown on the Drawings, or as hereinbefore specified.
- B. Castings shall be at least Class 25 conforming to the ASTM Standard Specifications for Gray Iron Castings, Designation A-48-64 except for the 12" NDS risers and 12" inlets.
- C. Sanitary sewer covers shall have the name "Sewer" cast therein. Storm drain covers shall have the name "Storm" cast therein. Other castings shall have an appropriate name (i.e. Electric, telephone etc.)
- D. The manhole castings shall be the equal of the Portland standard non-perforated manhole frame and cover M 24 x 8-S weighing approximately 425 pounds as manufactured by the Etheridge Foundry Company, or Catalog No. LK610 as manufactured by the E.L. LeBaron Foundry Company.

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- E. Catch basins castings shall have frames conforming to S 24" x 8 square by Etheridge with a 24" square type "M" bicycle safe grate or catalog LK 124 (LeBaron), unless otherwise noted on the drawings.

2.3 MORTAR

- A. Mortar used to adjust rims and covers for manholes shall consist of the following materials and proportions by volume: 1 part of Portland cement; 1/4 part lime hydrate; and 3 parts sand.
- B. For precast reinforced concrete manholes, mortar for invert construction shall consist of the following materials and proportions by volume: 1 part Portland cement and 2 parts sand. Quantity of water in mixture shall be sufficient to produce a stiff, workable mortar, but in no case shall exceed 5-1/2 gallons of water per sack of cement.

2.4 BRICK

- A. Brick for manholes and catch basins shall meet Standard Specifications for Sewer Brick, AASHTO Designation M-91-42, Grade SA, Size No. 1 wire cut. Any brick rejected by the Engineer as unsuitable shall be immediately removed from the work.

2.5 VENTS

- A. Vents, when required by the Contract Drawings, shall be constructed of galvanized piping of the diameter indicated on the plans with a minimum size of 4" with threaded joints. The top of the vent shall have a minimum of 12 square inches of screened opening to permit air passage, and a cap to prevent extraneous material from entering the vent. The cap shall not interfere with the air passage. Vents shall be connected to appurtenances using a cast in wall pipe.

2.6 SITE CONCRETE

- A. Site concrete shall meet the requirements set forth below:
 - 1. Aggregate: The aggregate shall conform to the Standard Specifications for Concrete Aggregates, ASTM Designation C-33, as revised.
 - (a) Sand shall be a medium sand with a fineness modules of 2.60 - 2.90.
 - (b) Coarse aggregate shall not exceed 1-1/2 inches for mass concrete.
 - 2. Cement: All cement shall be a Portland Cement conforming to the requirements of Standard Specifications of the American Society for Testing Materials, Designation C-150, as revised, Type II. An air entraining agent, approved by the Engineer, shall be used.

3. Proportioning Concrete:

<u>Maximum Size Coarse Aggregate (Inches)</u>	<u>Air Content Percent by Volume</u>
1-1/2, 2, or 2-1/2	5 +/- 1
3/4 or 1	6 +/- 1

The strength of the concrete shall be fixed in terms of water-cement ratio in accordance with trial batches of the materials to be used. All concrete placed under this Specification shall be mixed in the ratio not to exceed six (6) U.S. gallons of water per sack of cement, including surface water carried by the aggregate in each case. The Contractor shall determine the approximate amount of surface water contained in the aggregate, and make proper allowance. Concrete shall have a minimum 28 day strength of 3750 psi.

The Contractor shall submit the proposed mix proportions to the Engineer for approval ten (10) days prior to placing concrete. Copies of recent test results for the proposed mix design shall also be submitted.

2.7 REINFORCEMENT

- A. The Contractor shall submit detailed shop drawings for concrete reinforcement in accordance with ACI 318 and ACI 315. The steel shall be deformed Grade 60 bars which conform to ASTM 615, ASTM 616, or ASTM 617. Supports, spaces, and chairs shall permit the steel to be supported in accordance with ACI 318.

2.8 INSULATION

- A. Insulation, when required by the Drawings, shall be Styrofoam SM or TG as manufactured by the Dow Chemical Company or equal.
- B. Material submitted shall have a K factor of .20 @ 75 degrees by ASTM C518-70, 2-lb. density by ASTM C303-56, compressive strength of 30-lb. by ASTM D1621-64 and a water absorption of less than .05% by ASTM C272-53 and meet Federal Specification HH1524B Type II, Class B.
- C. The Contractor shall coat the insulation material in accordance with the manufacturer's instructions.

2.9 TREATMENT OF INTERIOR SURFACES

- A. All interior surface of cast in place concrete structures shall have a liquid hardener applied. The application shall consist of two coats of VANDEX or approved equal installed in accordance with manufacturer's instructions including requirements for surface preparation. Catalog cuts of the hardener shall be submitted to the Engineer for approval. All interiors of concrete items shall be treated with a waterproof coating (18 mil. Film thickness).

2.10 TREATMENT OF EXPOSED SURFACES

- A. All exposed exterior concrete surfaces shall have a "rub finish". Structures and appurtenances shall have an applied coating of Tnemec Series 104 H5 Epoxy applied in 2 coats or approved equal to achieve a minimum dry film thickness of 18 mils. All light pole bases shall have an epoxy finish colored to match the pole color. One coat shall be applied in the factory, a second coat shall be applied in the field.

2.11 TREATMENT OF ALL OTHER EXTERIOR SURFACES

- A. All buried surfaces shall be double coated with a concrete hardener to achieve a minimum dry film thickness of 18 mils.

2.13 RAIN GUARD MANHOLE INSET

- A. A self sealing removable insert shall be provided and installed in the frame of each manhole casting on sewer lines. The purpose of this device is to collect and store illicit water that may enter the manhole casting. The units shall be "RAINGUARD™" or approved equal.

PART 3 - EXECUTION

3.1 MANHOLES

- A. General: All appurtenant structures shall be set level on compacted material as specified in Section 2 of these Specifications and as shown on the Plans.
- B. Manhole Channels: Channels shall be constructed in all sanitary sewer manholes in accordance with the details shown on the Plans by a mason whose qualifications meet the approval of the Engineer or a preformed manhole channel: "FIBERLINER" or equal. The sides shall be raised by brick masonry construction from the spring line perpendicular to the height of the crown of the pipe. Where changes in directions are made at manholes, the invert shall be shaped with as great a radius as possible, and to the complete satisfaction of the Engineer. Brick shall be carefully laid to present a smooth surface as indicated on the Plans and to the satisfaction of the Engineer.
- C. Pipe Connections:
 - 1. Stubs in Manholes: Stubs placed as specified and indicated on the Drawings shall be short pieces cut from the bell ends of appropriate pipe and shall have compatible watertight stoppers. Stubs shall be set accurately to the required line and elevation and encased in the structure masonry as indicated on the Drawings.
 - 2. Wall Sleeves and Castings: Wall sleeves and castings as specified and indicated on the Drawings shall be accurately cast to the required location and elevations as indicated on the Drawings.

- D. Steps: Manhole and appurtenant steps shall be cast in the wall and installed in a straight vertical alignment.
- E. Infiltration Seal: Install rain guard or approved equal manhole inserts.

3.2 ALTERATIONS TO EXISTING MANHOLES

- A. Existing manholes to be altered shall be reconstructed as indicated on the Plans or as directed by the Engineer. Adjusting to grade or connecting to an existing pipe stub is not considered an alteration.
- B. Alterations covered include, but are not limited to, adjustments to manhole invert channel caused by new pipe connections or removal of existing pipe connections, and removal and plugging of existing catch basin lead and replacing with a new lead connection conforming to the appropriate section of the Specifications contained herein.

3.3 ADJUSTING EXISTING MANHOLES

- A. Existing manholes to be adjusted to grade shall be reconstructed to the required grade. The existing frames, grates, and covers shall be re-used unless otherwise directed.
- B. The existing structure shall be dismantled to a sufficient depth to allow reconstruction conforming to the standard details.
- C. Adjustment will take place just prior to placing of surface pavement for adjustments of the frame and cover. Adjustments which require dismantling and reconstruction of the super structure shall be accomplished at the time of subgrade preparation. Pavement which is removed for this adjustment shall be cut square, tack coated, and capped with 2" of bituminous concrete. No separate payment will be made for furnishing the bituminous cap.
- D. Each structure that is adjusted shall be cleaned of accumulated silt, debris, or foreign matter prior to final acceptance of the work.

3.4 ABANDONING MANHOLES

- A. Existing manholes designated to be abandoned shall be removed to a depth of one (1) foot below the subgrade line, unless otherwise indicated on the Plans or directed by the Engineer. The existing pipes shall be plugged with concrete and brick masonry and the catch basins and manholes shall be filled with heavy gravel satisfactorily compacted in 9 inch lifts. Prior to backfilling, the sump shall be pumped and cleaned of all water and foreign material.

3.5 MANHOLE ADAPTERS

- A. When altering an existing manhole or where a pre manufactured manhole adapter cannot be installed in precast manhole sections, the Contractor shall use a Fernco, or equal, concrete manhole adapter. The adapter shall be designed to provide a positive, watertight seal between

the manhole and pipe and shall be mortared in place with Five Star grout or approved equal non-shrink grout.

3.6 PRECAST TANKS, VAULTS, AND APPURTENANCES

A. These precast items shall be set in a dry excavation, proof-rolled, and prepared with one of the following bedding materials:

- Compacted ¾" crushed stone (8" min.),
- Compacted MDOT 703.06 Type D gravel.

If the subgrade is weak and/or unstable, a layer of Mirafi 600X shall be installed between the prepared subgrade and the bedding.

B. The anti-flotation slab shall be carefully laid out and aligned, and set on the bedding with reinforcement and forms set on a dry excavation site. Concrete shall be poured and protected from inclement weather during the cure period.

C. Tanks shall be set on the anti-flotation slab. Where necessary for plumbness and level, the tank shall be shimmed with a strong slurry grout installed to fill the void space.

D. Multiple section tanks shall be set in place using approved sealants. Double rows shall be required when joint mastics are used. An approved adhesive primer shall be installed prior to installing the mastics and setting the concrete.

E. The tank shall be anchored to the anti-flotation slab with approved stainless steel masonry anchors. All anchors shall be inspected by the contractor to assure the anchor is secure and will provide the required resistance.

F. After anchorage, the tank excavation shall remain dewatered and backfilled. The backfill shall be brought up uniformly around the tank and compacted in place. Pipe connections shall occur after the tank has been backfilled to the level of the bottom of the pipe bedding.

G. Any voids created by removal of sheeting, bracing or shielding shall be filled and recompacted.

PART 4 - TESTING

4.1 GENERAL

All sanitary manholes, wetwells, septic tanks, holding tanks, and other appurtenant structures shall be tested as to water tightness. If the initial test fails a retest shall be required. The Contractor has the option of either of the following methods:

A. Water Test: The inlet and outlet of the structure shall be plugged by watertight plugs furnished by the Contractor, and the manhole shall be filled with water. The water shall remain for sufficient time for the absorption into the concrete pipe to have been substantially completed. The amount of water loss from the manhole shall then be determined. The rate shall not exceed

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five (5) gallons per hour. Obvious leaks shall be repaired by the Contractor by excavating outside the structure, if required, at no cost to the Owner.

- B. Vacuum: The manholes shall be vacuum tested by a method and apparatus subject to the prior approval of the Engineer. Vacuum testing shall be performed in the following manner:

The manhole shall be fully assembled, including all pipe connections into the structure. The manhole shall be in its final location and shall not have been backfilled prior to the performance of the test.

All lift holes shall be plugged with a non-shrinking mortar, as approved by the Engineer.

The seal between the manhole sections shall be in accordance with ASTM C923.

The Contractor shall plug the pipe openings, taking care to securely brace the plugs and the pipe.

With the vacuum tester set in place:

- Inflate the compression band to effect a seal between the vacuum base and the structure.
- Connect the vacuum pump to the outlet port with the valve open.
- Draw a vacuum to 10" of Hg. and close the valve.
- The test shall pass if the vacuum remains at 10" Hg. or drops to 9" Hg. in a time greater than one minute. If the manhole fails the initial test, the Contractor shall locate the leak and make proper repairs. Leaks may be filled with a wet slurry of accepted quick setting material.

Any appurtenant structure which shows obvious infiltration, whether tested or not, shall be sealed to eliminate said infiltration.

END OF SECTION 333900

SECTION 334100 - STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes gravity-flow, non-pressure storm drainage outside the building, with the following components:
1. Cleanouts.
 2. Precast concrete manholes.
 3. Flared inlets/outlets.
 4. Catch basins.
 5. Detention pond hydraulic control manholes.
 6. Temporary pond risers.

1.2 RELATED DOCUMENTS – Vacant

1.3 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Nonpressure, Drainage-Piping Pressure Rating: Watertight when installed below permanent pond elevation, silt tight in other areas.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For manholes and catch basins. Include plans, elevations, sections, details, and manhole frames and covers and catch basin frames and grates.
- C. Coordination Drawings: Show pipe sizes, locations, and elevations for all manholes and appurtenances.
- D. Field quality-control test reports. Product Data: For each type of product indicated.

1.5 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly beside pipe to midpoint of pipe, prior to subsequent backfill operations.
- B. Special Backfill: Fill placed above bedding beside and over pipe prior to other backfill operations.

1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record actual locations of pipes and mains, connections, catch basins, cleanouts and invert elevations.
- B. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.7 COORDINATION

- A. Coordinate the work with termination of storm connections outside building and trenching.
- B. The exact location of roof drain leaders shall be determined from the Architectural Plans and including as shown on the plumbing drawings. The number and location of the roof drains may be different than shown in the site drawings. Verify roof drain lead locations with the Owner. Provide fittings to raise grade to accept roof drain 5'-0" outside of building where necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

Provide any one of the following materials subject to any restrictions noted in this subsection or on plans. The contractor shall provide catalog cuts to the Owner and indicate the proposed materials to be used prior to ordering materials. The approval of the Owner must be obtained prior to ordering materials.

- A. Reinforced Concrete Pipe: Comply with requirements of ASTM C 76, Class IV unless another class type is indicated on Drawings, installed with flexible plastic (Bitumen) gaskets at all joints. Gaskets shall comply with AASHTO M-198 75I, Type B, and shall be installed in strict accordance with pipe manufacturer's recommendations.
- B. Polyvinyl Chloride (PVC) Pipe: Pipe and fittings shall comply with ASTM D 3034, rated SDR 35. Pipe shall be continually marked with manufacturer's name, pipe size, cell classification, SDR rating, and ASTM D 3034 classification. Pipe joints shall be integrally molded bell ends in accordance with ASTM D 3034, Table 2, with factory supplied elastomeric gaskets and lubricant. PVC shall not be used for any drainage pipe which will be permanently exposed to sunlight.
- C. Corrugated Polyethylene Pipe (CPP), Smooth Interior: Shall conform with AASHTO Designations M294 and M252. Pipe must be installed in accordance with manufacturer's installation guidelines for culvert and other heavy duty drainage applications. Acceptable manufacturers: Advanced Drainage Systems, Inc. (ADS) N-12 and HANCOR, INC. (HiQ smooth interior). CPP pipe shall not be used for any drainage pipe which will be permanently exposed to sunlight. Piping below the water table, subject to surcharge, or which could affect a pond level, shall be watertight. All other piping shall be silt tight.

- D. Polyvinyl Chloride (PVC) Large Diameter Closed Profile Gravity Sewer Pipe, UNL-B-9: Pipe and fittings shall be installed in accordance with pipe manufacturer's installation guidelines. Acceptable manufacturer: CARLON (Vylon HC). PVC pipe shall not be used for any drainage pipe which will be permanently exposed to sunlight.
- E. Storm drain inlets, outlets, and culverts to include:
- Rip rapped aprons.
 - Concrete flared inlets/outlets for pipes larger than 18" in diameter.
 - Bar racks for pipes larger than 18" diameter.
 - HDPE flares for pipe smaller than 18" in diameter. High density polyethylene flares with added carbon black for exposure to sunlight.
- F. Manholes and Catch Basins Outlet Control Structures, Stilling, Basins, Water Quality Unit, and Water Quality Control Structures shall be provided where shown on the contract drawings.

2.2 CLEANOUTS

- A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
1. Manufacturers:
 - a. Josam Company.
 - b. MIFAB Manufacturing Inc.
 - c. Smith, Jay R. Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Watts Industries, Inc.
 - f. Watts Industries, Inc.; Enpoco, Inc. Div.
 - g. Zurn Industries, Inc.; Zurn Specification Drainage Operation.
 2. Top-Loading Classification(s): Heavy duty.
 3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

2.3 MANHOLES

- A. Standard Precast Concrete Manholes: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
1. Diameter: 48 inches (1200 mm) minimum, unless otherwise indicated.
 2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
 3. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (100-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.

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4. Riser Sections: 4-inch (100-mm) minimum thickness, and of length to provide depth indicated.
5. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
6. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.
7. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into manhole walls, for each pipe connection.
8. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on 1 step and designed to prevent lateral slippage off of step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of manhole to finished grade is less than 36 inches (900 mm).
9. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and diameter matching manhole frame and cover. Include sealant recommended by ring manufacturer.
10. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
11. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 8-inch (203-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."
 - a. Material: ASTM A 48, Class 35 gray iron, unless otherwise indicated.

2.4 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318/318R, ACI 350R, and the following:
 1. Cement: ASTM C 150, Type II.
 2. Fine Aggregate: ASTM C 33, sand.
 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 4. Water: Potable.
- B. Ballast and Pipe Supports: Portland cement design mix, 3000 psi (20.7 MPa) minimum, with 0.58 maximum water-cementitious materials ratio.
 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 2. Reinforcement Bars: ASTM A 615/A 615M, Grade 60 (420 MPa), deformed steel.

2.5 CATCH BASINS

- A. Standard Precast Concrete Catch Basins: ASTM C 478 (ASTM C 478M), precast, reinforced concrete, of depth indicated, with provision for sealant joints.
 1. Base Section: 6-inch (150-mm) minimum thickness for floor slab and 4-inch (102-mm) minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
 2. Top Section: Eccentric-cone type unless flat-slab-top type is indicated.
 3. Joint Sealant: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.

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- B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for A-16, structural loading. Include 24-inch (610-mm) by 8-inch (203-mm) rectangular riser with 4-inch (102-mm) minimum width flange bicycle proof drainage openings.
1. Grate Free Area: Approximately 50 percent, unless otherwise indicated.
 2. The location of catch basins shall be accurately located by a registered land surveyor. Catch basins shall be located as follows:

Edge of frame 6" off face of curb where shown near slopes granite or bit concrete curblines.
The center of aisle or parking modules when shown on plans.
In other cases, verify with Engineer.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Pipe couplings and fittings with pressure ratings at least equal to piping rating may be used in applications below, unless otherwise indicated.
1. Use non pressure-type flexible couplings where required to join gravity-flow, non pressure sewer piping, unless otherwise indicated.
 - a. Flexible couplings for same or minor difference OD pipes.
 - b. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.
- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. Install gravity-flow, non pressure drainage piping according to the following:
1. Install piping pitched down in direction of flow, at the slope provided on the contract drawing.

2. The pipe shall be accurately laid to the line and grades to the satisfaction of the Engineer. The line and grade may be adjusted by the Engineer from that shown on the Drawings to meet field conditions and no extra compensation shall be claimed therefore.

The Owner or his representative reserves the right to check the elevations and alignment on any pipe for conformance with proposed line and grade. Installed grades shall be within the tolerance of plus or minus 0.02 feet from theoretical computed grades. Alignment shall be within a tolerance of plus or minus 0.04 feet. Pipe grade shall be defined as the invert elevation of the pipe. Pipe not meeting the grade tolerance or of poor alignment shall be adjusted by the Contractor.

3. No pipe laying will be allowed to begin at any point other than a manhole or other appurtenance without the expressed consent of the Engineer. The interior of each length of pipe will be swabbed and wiped clean before laying the next length. No length of pipe shall be laid until the previous length has had sufficient fine material placed and tamped about it to secure it firmly in place to prevent any disturbance. Bell ends shall be laid uphill. Whenever the work is stopped temporarily, or for any reason whatsoever, the end of the pipe shall be carefully protected against dirt, water, or other extraneous material. Bedding shall be as shown on the Plans.
4. The pipe shall be cut as necessary for appurtenances. In general, the pipe material shall be cut by using a saw or milling process, approved by the pipe manufacturer and not by using any impact device, such as a hammer and chisel, to break the pipe. The pipe shall be cut, not broken. The cut end of the pipe shall be square to the axis of the pipe and any rough edges ground smooth.
5. Clean interior of all pipe thoroughly before installation. When work is not in progress, open ends of pipe shall be closed securely, in a manner approved by the Engineer, to prevent entrance of trench water, dirt, or other substances.
6. All joints shall be made in a dry trench in accordance with the manufacturer's recommendations.
7. A minimum of two (2) pipe lengths or pipe stubs shall be used between any two (2) appurtenances.
8. When connections are made between new work and existing piping, make connection using suitable fittings for conditions encountered. Make each connection with existing pipe at time and under conditions which least interfere with operation of existing pipeline service. Provide facilities for dewatering and for disposal of water removed from dewatering lines and excavations without damage to adjacent properties.
9. Install piping below frost line.
10. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
11. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

- F. Clear interior of piping and manholes of dirt and superfluous material as work progresses.

3.3 PIPE JOINT CONSTRUCTION

- A. Basic pipe joint construction is specified in Division 33 Section "Common Work Results for Utilities." Where specific joint construction is not indicated, follow piping manufacturer's written instructions.
- B. Join gravity-flow, non pressure drainage piping according to the following:

1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
2. Join PVC sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-gasket joints.
3. Join dissimilar pipe materials with non pressure-type flexible couplings.

3.4 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
 1. Use light-duty, top-loading classification cleanouts in earth or unpaved foot-traffic areas.
 2. Use medium-duty, top-loading classification cleanouts in paved foot-traffic areas.
 3. Use heavy-duty, top-loading classification cleanouts in vehicle-traffic service areas.
 4. Use extra-heavy-duty, top-loading classification cleanouts in roads.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch (25 mm) above surrounding grade in lawn areas.
- C. Set cleanout frames and covers in pavement with tops flush with pavement surface.

3.5 MANHOLE INSTALLATION

- A. General: Install manholes, complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 0-1" (0-25 mm) above finished surface elsewhere, unless otherwise indicated.

3.6 CATCH BASIN INSTALLATION

- A. Set frames and grates to elevations indicated.
- B. Outlet Control Structure: Provide precast concrete unit, covers, weirs, orifices and appurtenances as shown on the drawings. Provide information on the method, materials, installation, and quality control measures which will be used to seal the wall between the inlet and outlet side of the manhole.

Precast Tanks, Vaults and Appurtenances: Precast tanks, vaults, and appurtenances shall be constructed of precast reinforced concrete with inside dimensions conforming to those indicated on the contract drawings and conforming to ASTM C478. The tank may be a monolithic section or constructed with tongue and grooves with approved watertight sealants such as butyl sealant. All penetrations through the tank shall use either cast in place wall sleeves with Link Seals or a flexible boot secured in the casting such as Kor N Seal. Any clamps or metallic connections shall be stainless steel.

The tanks, vaults, and appurtenances shall include shop drawings and submittals with supporting computations which demonstrate the tank can support an H₂O loading, an equivalent external fluid pressure of 105 lb./cubic ft. (with the tank empty), and an internal fluid pressure of 65 lb./cubic ft. The pressures shall be assumed to apply from the base of the structure to the finish grade surface.

Tanks which require attachment to an anti-flotation slab shall use stainless steel angles and anchors sized to resist the uplift force.

The tanks shall be coated with a waterproof seal on the interior and exterior. Sections shall be fabricated to receive a watertight seal.

3.7 MANHOLES

- A. General: All appurtenant structures shall be set level on compacted material as specified in Section 2 of these Specifications and as shown on the Plans.
- B. Manhole Channels: Channels shall be constructed in all sanitary sewer and storm drain manholes in accordance with the details shown on the Plans by a mason whose qualifications meet the approval of the Engineer or a preformed manhole channel: "FIBERLINER" or equal. The sides shall be raised by brick masonry construction from the spring line perpendicular to the height of the crown of the pipe. Where changes in directions are made at manholes, the invert shall be shaped with as great a radius as possible, and to the complete satisfaction of the Engineer. Brick shall be carefully laid to present a smooth surface as indicated on the Plans and to the satisfaction of the Engineer.
- C. Pipe Connections:
 - 1. Stubs in Manholes: Stubs placed as specified and indicated on the Drawings shall be short pieces cut from the bell ends of appropriate pipe and shall have compatible watertight stoppers. Stubs shall be set accurately to the required line and elevation and encased in the structure masonry as indicated on the Drawings:
 - 2. Wall Sleeves and Castings: Wall sleeves and castings as specified and indicated on the Drawings shall be accurately cast to the required location and elevations as indicated on the Drawings.
- D. Steps: Manhole and appurtenant steps shall be cast in the wall and installed in a straight vertical alignment.

3.8 ALTERATIONS TO EXISTING MANHOLES AND CATCH BASINS

- A. Existing manholes and catch basins to be altered shall be reconstructed as indicated on the Plans or as directed by the Engineer. Adjusting to grade or connecting to an existing pipe stub is not considered an alteration.
- B. Alterations covered include, but are not limited to, adjustments to manhole invert channel caused by new pipe connections or removal of existing pipe connections, and removal and

plugging of existing catch basin lead and replacing with a new lead connection conforming to the appropriate section of the Specifications contained herein.

3.9 ADJUSTING EXISTING MANHOLES AND CATCH BASINS

- A. Existing manholes and catch basins to be adjusted to grade shall be reconstructed to the required grade. The existing frames, grates, and covers shall be re-used unless otherwise directed.
- B. The existing structure shall be dismantled to a sufficient depth to allow reconstruction conforming to the standard details.
- C. Adjustment will take place just prior to placing of surface pavement for adjustments of the frame and cover. Adjustments which require dismantling and reconstruction of the super structure shall be accomplished at the time of subgrade preparation. Pavement which is removed for this adjustment shall be cut square, tack coated, and capped with 2" of bituminous concrete. No separate payment will be made for furnishing the bituminous cap.
- D. Each structure that is adjusted shall be cleaned of accumulated silt, debris, or foreign matter prior to final acceptance of the work.

3.10 ABANDONING EXISTING CATCH BASINS AND MANHOLES

- A. Existing catch basins and manholes designated to be abandoned shall be removed to a depth of one (1) foot below the subgrade line, unless otherwise indicated on the Plans or directed by the Engineer. The existing pipes shall be plugged with concrete and brick masonry and the catch basins and manholes shall be filled with heavy gravel satisfactorily compacted in 9 inch lifts. Prior to backfilling, the sump shall be pumped and cleaned of all water and foreign material.

3.11 MANHOLE ADAPTERS

- A. When altering an existing manhole or where a pre manufactured manhole adapter cannot be installed in precast manhole sections, the Contractor shall use a Fernco, or equal, concrete manhole adapter. The adapter shall be designed to provide a positive, watertight seal between the manhole and pipe and shall be mortared in place with Five Star grout or approved equal non-shrink grout.

3.12 PRECAST TANKS, VAULTS, AND APPURTENANCES

- A. These precast items shall be set in a dry excavation, proof-rolled, and prepared with one of the following bedding materials:

Compacted ¾" crushed stone (8" min.),
Compacted MDOT 703.06 Type D gravel.

If the subgrade is weak and/or unstable, a layer of Mirafi 600X shall be installed between the prepared subgrade and the bedding.

The anti-flotation slab shall be carefully laid out and aligned, and set on the bedding with reinforcement and forms set on a dry excavation site. Concrete shall be poured and protected from inclement weather during the cure period.

Tanks shall be set on the anti-flotation slab. Where necessary for plumbness and level, the tank shall be shimmed with a strong slurry grout installed to fill the void space.

Multiple section tanks shall be set in place using approved sealants. Double rows shall be required when joint mastics are used. An approved adhesive primer shall be installed prior to installing the mastics and setting the concrete.

The tank shall be anchored to the anti-flotation slab with approved stainless steel masonry anchors. All anchors shall be inspected by the contractor to assure the anchor is secure and will provide the required resistance.

After anchorage, the tank excavation shall remain dewatered and backfilled. The backfill shall be brought up uniformly around the tank and compacted in place. Pipe connections shall occur after the tank has been backfilled to the level of the bottom of the pipe bedding.

Any voids created by removal of sheeting, bracing or shielding shall be filled and recompactd.

3.13 CONNECTIONS

- A. Connect non pressure, gravity-flow drainage piping to building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."
- B. Make connections to existing piping and underground manholes.
 - 1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of concrete with 28-day compressive strength of 3000 psi (20.7 MPa).
 - 2. Insulation, when required by the Drawings, shall be Styrofoam SM or TG as manufactured by the Dow Chemical Company or equal.

Material submitted shall have a K factor of .20 @ 75 degrees by ASTM C518-70, 2-lb. density by ASTM C303-56, compressive strength of 30-lb. by ASTM D1621-64 and a water absorption of less than .05% by ASTM C272-53 and meet Federal Specification HH1524B Type II, Class B.

The Contractor shall coat the insulation material in accordance with the manufacturer's instructions.

3.14 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of Project.

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1. Submit separate report for each system inspection.
 2. Defects requiring correction include the following:
 - a. Horizontal Alignment: Less than full diameter of inside of pipe is visible between structures or ½” off design alignment.
 - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 - f. Vertical Alignment: Within ¼” of design grade.
 3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
 4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new watertight piping systems that have been installed below the elevation of the permanent pool in the wet pond.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to requirements of authorities having jurisdiction.
 3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
 4. Submit separate report for each test.
 5. Air Tests: Test storm drainage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
 - a. Option: Test plastic gravity sewer piping according to ASTM F 1417.
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 334100

SECTION 334600 - SUBDRAINAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes subdrainage systems for foundations and site areas. This includes perimeter foundation drains and underdrains that surround the building.

1.2 SUBMITTALS

- A. Product Data: For each type of drainage panel or piping indicated on the drawings.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Refer to the "Piping Applications" Article in Part 3 for applications of pipe, fitting, and joining materials.

2.2 PERFORATED-WALL PIPES AND FITTINGS

- A. Perforated PE Pipe and Fittings: ASTM F 405 or AASHTO M 252, Type CP; corrugated, for coupled joints.
 - 1. Couplings: Manufacturer's standard, band type.
- B. Perforated PVC Sewer Pipe and Fittings: ASTM D 2729, bell-and-spigot ends, for loose joints.

2.3 SOLID-WALL PIPES AND FITTINGS

- A. PE Drainage Tubing and Fittings: AASHTO M 252, Type S, corrugated, with smooth waterway, for coupled joints.
 - 1. Couplings: AASHTO M 252, corrugated, band type, matching tubing and fittings.
- B. PVC Sewer Pipe and Fittings: ASTM D 3034, SDR 35, bell-and-spigot ends, for gasketed joints.
 - 1. Gaskets: ASTM F 477, elastomeric seal.

2.4 SPECIAL PIPE COUPLINGS – Vacant

2.5 CLEANOUTS

- A. Cast-Iron Cleanouts: ASME A112.36.2M; with round-flanged, cast-iron housing; and secured, scoriated, Medium-Duty Loading class, cast-iron cover. Include cast-iron ferrule and countersunk, brass cleanout plug.

2.6 SOIL MATERIALS

- A. Backfill, drainage course, impervious fill, and satisfactory soil materials are specified in Division 31 Section "Earth Moving."

2.7 GEOTEXTILE FILTER FABRICS

- A. Description: Fabric of PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4480 to 13 440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING APPLICATIONS

- A. Underground Subdrainage Piping:
 - 1. Perforated PVC sewer pipe and fittings for loose, bell-and-spigot joints.
- B. Underslab Subdrainage Piping:
 - 1. Perforated PVC sewer pipe and fittings and loose, bell-and-spigot joints.
- C. Header Piping:
 - 1. PE drainage tubing and fittings, couplings, and coupled joints.
 - 2. PVC sewer pipe and fittings, couplings, and coupled joints.

3.3 CLEANOUT APPLICATIONS

- A. In Underground Subdrainage Piping:
 - 1. At Grade in Earth: PVC cleanouts.
 - 2. At Grade in Paved Areas: Cast-iron cleanouts.

3.4 FOUNDATION DRAINAGE AND UNDERDRAIN INSTALLATION

- A. Install drainage system at locations shown on the Drawings. Lay pipe flat with the invert positioned at invert elevation shown on the Drawings.
- B. Completely surround drainage pipe with a minimum of 6-inches of drainage course and geotextile filter fabric. Place pipe with joints tightly closed in accordance with manufacturer's recommendations so that flow lines conform to required grades. For perforated collector pipe, lay pipe with perforations down.
- C. Underslab drainage pipe, if used, will be embedded mid-height in a minimum 12 in. layer of drainage course directly below slabs where shown on the Drawings. Completely cover exposed soil subgrade below drainage course with geotextile filter fabric prior to placement of drainage course. Place pipe with joints tightly closed in accordance with manufacturer's recommendations so that flow lines conform to required grades. For perforated collector pipe, lay pipe with perforations down.
- D. Provide wall through penetrations at locations shown on the Drawings to allow connection of the perimeter and underslab drain piping, if used.
- E. Any sections of piping that are not true to lines and grades, or that show any undue settlement after being laid, or are damaged will be removed and re-laid or replaced at no additional cost.
- F. Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components, and retest system until satisfactory.
- G. Provide cleanouts for drainage piping at changes of direction, bend of lines, and wherever indicated on the Drawings, and necessary to enable system to be cleaned out. Extend cleanouts to finished grade or top of slab and provide surface protection. Coordinate cleanout locations with structural and architectural improvements.
- H. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
- I. Use increasers, reducers, and couplings made for different sizes or materials of pipes and fittings being connected. Reduction of pipe size in direction of flow is prohibited.
- J. Install PVC piping according to ASTM D 2321.

3.5 PIPE JOINT CONSTRUCTION

- A. Join PVC pipe and fittings according to ASTM D 3034 with elastomeric seal gaskets according to ASTM D 2321.
- B. Join perforated PVC pipe and fittings according to ASTM D 2729, with loose bell-and-spigot joints.
- C. Special Pipe Couplings: Join piping made of different materials and dimensions with special couplings made for this application. Use couplings that are compatible with and fit materials and dimensions of both pipes.

3.6 CLEANOUT INSTALLATION

A. Cleanouts for Foundation Subdrainage:

1. Install cleanouts from piping to grade. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. In vehicular-traffic areas, use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 18 by 18 by 12 inches (450 by 450 by 300 mm) in depth. Set top of cleanout flush with grade. Cast-iron pipe may also be used for cleanouts in non vehicular-traffic areas.
3. In non vehicular-traffic areas, use NPS 4 (DN 100) cast-iron pipe and fittings for piping branch fittings and riser extensions to cleanout. Set cleanout frames and covers in a cast-in-place concrete anchor, 12 by 12 by 4 inches (300 by 300 by 100 mm) in depth. Set top of cleanout plug 1 inch (25 mm) above grade.

B. Cleanouts for Underslab Subdrainage:

1. Install cleanouts and riser extensions from piping to top of slab. Locate cleanouts at beginning of piping run and at changes in direction. Install fittings so cleanouts open in direction of flow in piping.
2. Use NPS 4 (DN 100) cast-iron soil pipe and fittings for piping branch fittings and riser extensions to cleanout flush with top of slab.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect low elevations of subdrainage system to building's solid-wall-piping storm drainage system.
- C. Where required, connect low elevations of foundation underslab subdrainage to stormwater sump pumps.

3.8 FIELD QUALITY CONTROL

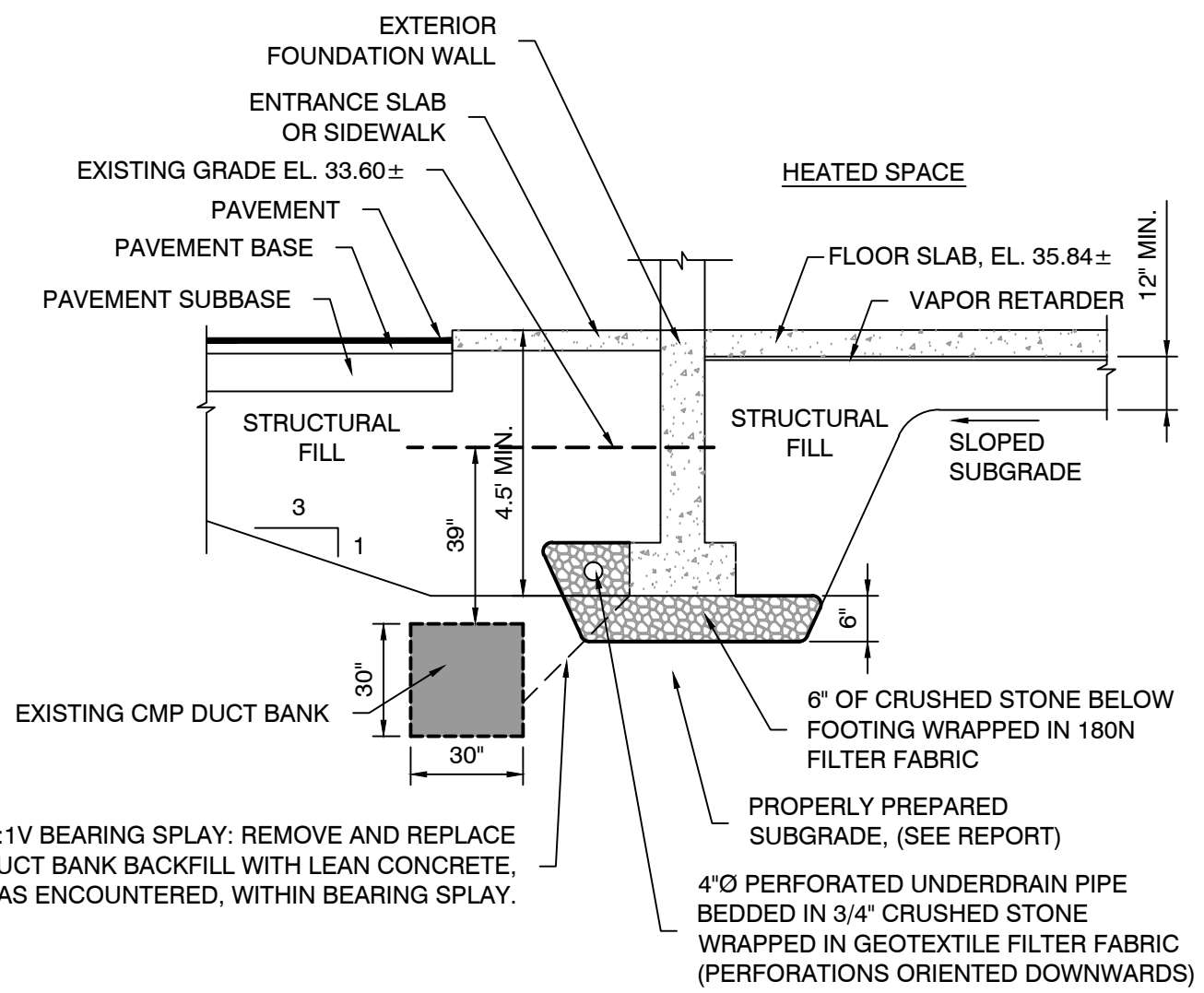
- A. Testing: After installing drainage course to top of piping, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.9 CLEANING

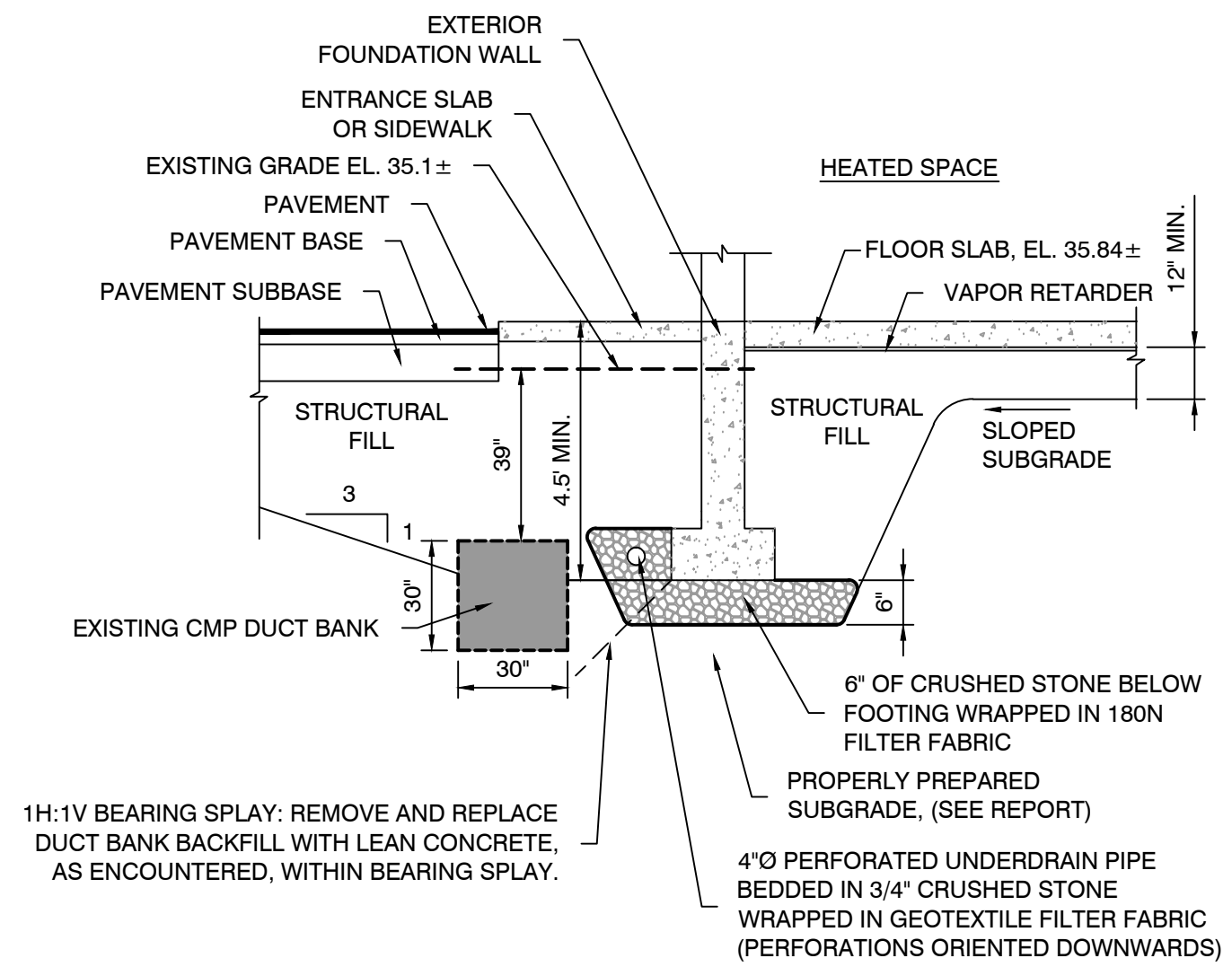
- A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 334600

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SOUTHWEST BUILDING CORNER




NORTHWEST BUILDING CORNER

NOTE:

1. UNDERDRAIN INSTALLATION AND MATERIAL GRADATION RECOMMENDATIONS ARE CONTAINED WITHIN THIS REPORT.
2. DETAIL IS PROVIDED FOR ILLUSTRATIVE PURPOSES ONLY, NOT FOR CONSTRUCTION.

NO.	DATE	DESCRIPTION	BY
1	06/12/2013	REVISED STONE BEDDING AND UNDERDRAIN, ADD CMP DUCT BANK	CEM



EYE CARE MEDICAL GROUP
UNDERDRAIN DETAIL

PROPOSED BUILDING ADDITION AND PARKING LOT
53 SEWALL STREET
PORTLAND, MAINE

Job No.:	13-0392	Scale:	Not to Scale
Date:	06/07/2013	Sheet:	10