Sandy Neck Beach Facility Reconfiguration
Town of Barnstable
Barnstable, Massachusetts

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SECTION 01110

SUMMARY OF WORK

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Work of the Contract is shown and described in Drawings and Project Manual entitled:

Sandy Neck Beach Facility Reconfiguration
Town of Barnstable
April 2025

Tighe & Bond, Inc.
Consulting Engineers
Westfield, Massachusetts

2. The Work includes the following major items:

a. Selective demolition of pavement and existing structures

b. Sand dune construction and reconfiguration

c. Implementation of site restoration and revegetation plan

d. Bituminous concrete parking lot construction including grading, curbing, vegetative swale construction, paving, guardrail, and stripping

e. New wood timber viewing platform, stairs, and access ramp

f. New stormwater management controls, manholes, catch basins, infiltration system, vegetated swales, and infiltration basin

g. Bituminous concrete paved access road and sidewalks

h. Site lighting

i. Electrical utility modifications and installation of new electrical, telephone, cable TV service, and fiber optics data line

j. Relocation of existing gatehouse building and foundation design

k. Installation of relocated gatehouse building foundation and utilities

l. Interior modifications to the relocated gatehouse

m. Construction of structures for air compressor equipment

n. Installation of air compressor equipment, air compressor piping, and fill stations

1.2 SUBMITTALS

A. Informational Submittals

1. Submit copies of permits or approvals required for the Work, prior to initiating the Work.

1.3 PROJECT/SITE CONDITIONS

A. Permits

1. Obtain the permits and approvals listed below:

a. National Pollution Discharge Elimination System (NPDES) Stormwater Permit

b. Permits and licenses of a temporary nature necessary to perform the Work.

c. Building permits from the Town of Barnstable and permits related to the septic system from Barnstable Board of Health.

d. Street opening permit from the Barnstable Department of Public Works.

e. Other permits or licenses required for the Contractor's operations or required elsewhere in the Contract Documents and not included herein.

2. Comply with the permits, approvals, and environmental protection plans listed below and attached to this Section:

a. Town of Barnstable Conservation Commission Order of Conditions (OOC).

b. Eastern Spadefoot Protection Plan (ESPP)

c. Conservation and Management Permit (CMP)

d. Town of Barnstable Board of Health Onsite Sewage Disposal System Variance Approval

e. Town of Barnstable Stormwater Management Permit

3. Obtain required time extensions to permits obtained by the Contractor, if construction authorized by permits has not been completed by the expiration date noted on these permits.

4. Permits require that a representative of the permitting authority or the Owner be present on site during construction or given the opportunity to observe conditions prior to backfilling or otherwise proceeding with construction. Notify the Owner, Engineer, and the permitting authority prior to performing Work that is governed by the permit.

5. Obtain permits and approvals from appropriate jurisdictional agencies and property owners for use of premises not furnished by the Owner, and for all off-site areas.

6. Submit copies of permits prior to performance of Work authorized by permits.

B. Existing Conditions

1. Use of Premises and Off-site Work

a. The Work shall occur on the Owner's property within the limits of Work shown on the Drawings.

b. Obtain permits and approvals for use of any land and access thereto that is deemed necessary for the Work, where such land is not available for use by the Owner, including land for temporary construction facilities, access

and egress, or for storage of materials. Confine apparatus and storage to such additional areas.

c. Obtain permits and written approvals from appropriate jurisdictional agencies for the use of premises not available for use by the Owner, including all offsite staging areas, borrow pits and waste areas. Submit copies of all permits and approvals to the Owner prior to using areas.

d. Provide for the disposal of waste materials off-site in accordance with all applicable laws.

e. Adhere to the Project Limits of Work, work schedule limitations, and coordination requirements of the Town's biologist regarding the Spadefoot Toad Protection areas as indicated,

f. Minimize obstruction to traffic and inconvenience to the Owner, general public, and residents in the vicinity of the Work, and to protect people and property.

g. Keep fire hydrants on or adjacent to the Work accessible to fire fighting equipment at all times.

h. Make temporary provisions for the use of sidewalks, trails, and maintain functioning gutters, stormwater systems, drainage ditches, and culverts.

i. Maintain public access to businesses and residences including driveways access roads, and parking lots at all times during the Work.

PART 2 PRODUCTS

2.1 MATERIALS FURNISHED BY OWNER

A. The Owner will furnish three air compressors and fiber optic network equipment for installation in the air compressor sheds. No other materials, labor or equipment will be furnished by the Owner under this Contract.

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01140

WORK RESTRICTIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Work Schedule
2. Construction Constraints
3. Vehicle Access
4. Available Work Area
5. Site Usage Plan

B. Related Requirements

1. Section 01110 – Summary of Work
2. Section 01310 - Coordination
3. Section 01325 - Scheduling of Construction

1.2 SUBMITTALS

A. Incorporate the requirements of this Section in the project schedule submitted under Section 01325.

B. Action Submittals

1. Submit site usage plan within 30 days of the Notice to Proceed.

1.3 WORK SCHEDULE

A. Conduct the Work during daylight hours on Monday through Friday, and within the time between 7:00 a.m. and 5:00 p.m. No work is to be done on Owner's holidays, Saturdays, Sundays or outside of the work hours described above unless prior consent is granted by the Owner.

B. Any Work with heavy machinery in the Toad Exclusion Areas labeled A, B, C, D, and E on the drawings must be completed by end of day March 31, 2026 with the exception of construction activities located solely on impervious surfaces and the planting or seeding of natural areas by hand or with hand tools.

C. Work on the coastal beach and seaward face of the dune (including dune restoration) shall be allowed during the shorebird breeding period, April 1 through August 31.

D. Cutting of paved surfaces, excavation within any paved roadway, or pavement resurfacing activities is not allowed from November 15th to April 1st.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 CONSTRUCTION CONSTRAINTS

A. The following are constraints for the Work. Incorporate these constraints into the schedule required to be submitted under Section 01325.

1. Public access to the lower beach parking lot to be maintained through September 14, 2025. Equipment and materials storage shall be restricted to the lower beach parking lot from September 15, 2025 through October 13, 2025.

2. Public access to the upper beach parking lot to be maintained until October 13, 2025. Starting October 14, 2025, public access to the upper parking lot may be restricted.

3. Construction on the dune areas allowed October 14, 2025 through March 31, 2026. No heavy equipment shall be allowed on the dune areas after March 31, 2026.

4. Public access to the offroad vehicle (ORV) trail entrance area and use of the amenities shall be maintained through November 10, 2025.

5. Public access to the existing and proposed Gatehouse Area shall be maintained through November 10, 2025. Full public access to the Gatehouse Areas shall be established by May 16, 2026

6. Toad Exclusion Areas:

   a. Areas A and B: Construction activities allowed October 14, 2025 through March 31, 2026.

   b. Areas C and D: Construction activities allowed September 15, 2025 through March 31, 2026

   c. Area E: Construction activities include clearing and grubbing, allowed October 14, 2025 through March 31, 2026.

   d. Areas F and G: Construction activities allowed October 14, 2025 through May 13, 2026.

7. Public access to the Marsh Trail entrance adjacent to the Gatehouse area shall be maintained throughout the project.

3.2 VEHICLE ACCESS

A. No vehicles will be permitted to travel beyond the Limit of Work, except where vehicle crossing locations have been approved in advance for Contractor access.

3.3 AVAILABLE WORK AREA

A. Limits of construction are defined on the Drawings. No work will be permitted to be performed outside these boundaries.

3.4 SITE USAGE PLAN

A. Submit a site usage plan showing all proposed staging areas, locations of all office and storage trailers, and material laydown areas. The site usage plan should be a drawing showing the proposed locations and shall include on-site traffic modifications and temporary utilities as may be applicable. Submit plan to Owner for review. Modify plan per Owner comments.

END OF SECTION

SECTION 01230

ALTERNATES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Alternate No. 1 – Off Road Vehicle (ORV) Trail Entrance Improvements

2. Alternate No. 2 – Observation Deck, Stairway, Walkway, and Platform

3. Alternate No. 2 – Interior Modifications to Gatehouse Building

1.2 DEFINITIONS

A. Alternate: An amount proposed by Bidder and stated on the bid form for certain work defined in this Section 01230 that may be added to the base bid amount if Owner decides to accept a corresponding change in the scope of construction to be completed either in quantity or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. The cost for each alternate is the net addition to the Contract Price to incorporate the Alternate into the Work. No other adjustments are made to the Contract Price.

1.3 PROCEDURES

A. Coordination: Modify or adjust affected adjacent Work as necessary to completely integrate the Alternate into the Work.

1. Include as part of each Alternate miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of the Alternate.

B. Execute accepted Alternates under the same conditions as other Work of the Contract.

1.4 ALTERNATES

A. Alternate No. 1 – ORV Trail Entrance Improvements

1. General

a. Alternate No. 1 includes all labor, equipment, materials required or incidental to the work as shown on the Drawings and Specifications for erosion control, demolition, site improvements, electrical and fiber optic utility improvements, gravel entrance, hot mix asphalt apron, sidewalk improvements, crosswalk line striping, lighting, construction of air compressor building -1, air compressor piping, and air up stations at the ORV Trail Entrance.

b. Coordination, completion of all permits, fees, inspections, and approvals as required by the Town of Barnstable and utility owners to complete the improvements to the ORV Trail Entrance.

2. Alternate No. 1 shall comply with all other requirements of Section 01140, including but not limited to submittals, quality assurance, sequencing, scheduling, preparation, and installation requirements.

B. Alternate No. 2 – Observation Deck, Stairway, Walkway, and Platform

1. General

a. Alternate No. 2 includes all labor, equipment, materials required or incidental to the work shown on the Drawings and Specifications for construction of the timber stairways, walkways, and platform.

b. Alternate No.2 includes the design, subsurface investigation, and installation required for the helical pile system, all labor equipment, and materials required or incidental to the work shown on the Drawings and Specifications.

c. Coordination, submission of all permits, fees, inspections, and approval as required by the Town of Barnstable to complete construction of the observation deck, stairway, walkway, and platform are included in Alternate No. 2.

2. Alternate No. 2 shall comply with all other requirements of Section 01140, including but not limited to submittals, quality assurance, sequencing, scheduling, preparation, and installation requirements.

C. Alternate No. 3 – Interior Modifications to Gatehouse Building

1. General

a. Alternate No. 3 includes all labor, equipment, materials or incidental to the work shown on the Drawings and Specifications for demolitions, modification, and installation of interior walls, flooring repairs, doors, and doorways, and electrical modifications.

b. Coordination, completion of all permits, fees, inspections, and approvals as required by the Town of Barnstable to complete the interior walls, doors, and doorway modifications to the gatehouse building.

2. Alternate No. 3 shall comply with all other requirements of Section 01140, including but not limited to submittals, quality assurance, sequencing, scheduling, preparation, and installation requirements.

3. Alternate No. 3 does not include the exterior or interior work required to temporarily disconnect and then reconnect all building utilities (including the sewer and water services) associated with relocating the gatehouse building. This work shall be included in the base bid price.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01290

APPLICATION AND CERTIFICATE FOR PAYMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Definition and description of measurement and payment to be used for the Work

2. Payment procedures

3. Payment requests for stored materials

B. Related Requirements

1. Section 01295 - Schedule of Values

1.2 GENERAL

A. The following paragraphs describe payment procedures for the work to be done under the respective items in the Bid Form.

B. Each lump sum and unit price will be deemed to include an amount considered by the Contractor to be adequate to cover the Contractor's overhead and profit for each separately identified item.

C. Except as provided for in Section 01295, no separate measurement or payment will be made for Work called for in Division 0 or Division 1 of the Contract Specifications, unless specifically covered under the Bid items listed below. All costs associated with this Work will be considered incidental to the Contract Bid price.

D. Division 2 through Division 16 Work will be measured and paid for at the Contractor's lump sum Bid price as indicated on the Bid form. Those payable Work items, and related prices as Bid, will be the basis for all compensation to the Contractor for Work performed under this Contract. Work not specifically included as a Bid item, but which is required to properly and satisfactorily complete the Work is considered ancillary and incidental to the Bid item Work, and payment for such Work is considered to be included in the values as Bid for payable items.

1.3 LUMP SUM ITEMS

A. Each lump sum price stated in the Bid form shall constitute full compensation for all labor, equipment and materials necessary and required to complete the work specified under that particular item, and also all costs for doing related work as set forth in the Contract Documents or implied in carrying out their intent.

B. Item 1 - Sandy Neck Beach Facility Reconfiguration Project

1. Measurement

a. There will be no measurement of quantities for lump sum items. Periodic partial payments for this Work, included under the Agreement, shall be based on the percent completion of each work item listed in the Schedule of Values provided under Section 01295 estimated by the Contractor and approved by the Engineer.

2. Payment

a. The lump sum payment shall be full compensation for furnishing all labor, materials, tools, equipment, and services necessary for the construction of the Sandy Neck Beach Facility Reconfiguration Project, in its entirety as detailed in the Contract Documents.

1.4 PAYMENT PROCEDURES

A. Informal submittal: Unless otherwise directed by the Engineer:

1. Make an informal submittal of request for payment by filling in, with erasable pencil, pertinent portions of EJCDC C-620, Contractor's Application for Payment, plus continuation sheet or sheets.

2. Make this preliminary submittal to the Engineer for review.

3. Revise the preliminary submittal as approved by the Engineer and incorporate the approved payments into the formal submittal.

B. Formal submittal: Unless otherwise directed by the Engineer:

1. Make formal submittal of request for payment by filling in the agreed data, by typewriter or electronically on EJCDC C-620, Contractor's Application for Payment, plus continuation sheet or sheets.

2. Sign and notarize the Application for Payment.

3. Submit the original of the Application for Payment, plus six identical copies of the continuation sheet or sheets, to the Engineer.

4. The Engineer will compare the formal submittal with the approved informal submittal and, if acceptable, will sign the Contractor's Application for Payment, and present the Application to the Owner.

5. Provide a signed and notarized Certificate for Stored Materials and proof of storage in a dry, watertight, heated and insured warehouse facility.

1.5 PAYMENT REQUESTS FOR STORED MATERIALS

A. Requests for payment for stored materials shall be made in accordance with Article 12 of the General Conditions and shall be accompanied by the attached "Certificate for Stored Materials" form. Payment for stored materials shall not exceed the value actually paid by the Contractor for the stored materials as evidenced by the accompanying bill of sale, invoice, or other documentation.

B. Partial payment requests for materials stored or so-called "engineering costs" by equipment manufacturers will not be allowed. All such costs shall be distributed proportionately among the various items of equipment/hardware to be furnished.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

CERTIFICATE FOR STORED MATERIALS

_____
Tighe & Bond Project No. B-0633-008

We, _____, request payment for materials and/or equipment not incorporated in the work included under our firm's contract with _____ as listed below.

We hereby certify under penalty of perjury, that the materials not incorporated in the work have been delivered and are securely stored at the site or at _____ and that we have title to said materials free and clear of all Liens, as evidenced by the attached bill of sale, invoice, or other documentation.

We also certify that an inventory of said materials and/or equipment has been compiled for the purposes of this monthly partial payment request. This list of materials and/or equipment, including unit prices for said material not incorporated in the work for which payment is hereby requested, consisting of _____ pages and dated _____, is signed and attached hereto.

We acknowledge that payments made based on this request for materials and/or equipment not incorporated in the work does not relieve the contractor of its responsibility for furnishing all materials and equipment required for the satisfactory completion of the project pursuant to the contractual requirements.

We further certify that we can and will adequately protect said materials and/or equipment until they are incorporated in the work; that they meet the requirements of the specifications, and that they will be needed for incorporation in the work in the near future.

IN WITNESS WHEREOF, we, the said _____ hereunto set our hand and seal this _____ day of _____, 20__.

_____
Contractor's Firm Name

SIGNED, SEALED AND DELIVERED IN THE PRESENCE OF

By_____

Title _____

_____
Notary Public

SCHEDULE OF STORED MATERIALS

Job No. _____
Contract No. _____
Contractor: _____
Location: _____
_____

Date _____
Pay Estimate _____

Item	Description	Supplier/Manufacturer	Quantity Stored and not Incorporated	Unit $	Certified Value

Signature: _____
Contractor's Principal

Total Amount Due for Stored Materials _____

Title: _____

SECTION 01295

SCHEDULE OF VALUES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Schedule of Values

1.2 SUBMITTALS

A. Action Submittals

1. Submit 3 copies of the Schedule of Values for approval within 10 days after the Effective Date of the Agreement.

1.3 SCHEDULE OF VALUES

A. Schedule of Values shall be a detailed breakdown of the lump sum Work items showing values allocated to the various elements of the Work.

B. The format of the Schedule of Values shall be a breakdown by Specification Section and content and shall be submitted on EJCDC C-620, Contractor's Application for Payment. The Engineer may require additional detailed documentation to support the values in the form of executed purchase orders, subcontracts, or other agreements.

C. The Engineer will determine the level of breakdown and detail required. The breakdown shall include materials, installation, and start-up for equipment and controls where applicable. The final document will be the basis of payment requests for the duration of the Contract. No progress payment will be made until the Schedule of Values is approved by the Engineer.

D. An unbalanced Schedule of Values providing overpayment on items of work performed first will not be accepted.

E. At the Contractor's option, items for mobilization and demobilization may be included in the Schedule of Values. The combined value shall not exceed 5 percent of the Contract Price, and the values for mobilization and demobilization shall be equal. Payment for mobilization will be included in the first payment request after the Contractor has initiated full-time construction activity. Payment for demobilization will be included in the first payment request after Substantial Completion has been reached and all equipment has been removed from the Site.

F. At the Contractor's option, an item for bonds and insurance may be included in the Schedule of Values. If included, requests for payment including values for bonds and insurance shall be accompanied by matching invoices.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

SECTION 01310

COORDINATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Project Management
2. Coordination
3. Project Meetings

B. Related Requirements

1. Section 01140 - Work Restrictions
2. Section 01325 - Scheduling of Construction

C. Related Work Not Included

1. Operation of existing facilities will be performed by the Owner unless otherwise specified. The Owner will assist in arranging operation of any existing facilities or equipment required by the Contractor to connect to existing facilities, and the Contractor shall not operate existing valves or equipment. Only the Owner will operate Owner valves and equipment.

1.2 SUBMITTALS

A. Incorporate the requirements of this Section, as well as Work which may impact the existing system operation, or the operations of any adjacent utility, in the project schedule submitted under Section 01325.

B. Informational Submittals

1. Submit to the affected utility company, the Owner, and the Engineer, in writing, all requests for temporary shutdowns of facilities or interruption of operations. No shutdowns of the utilities or interruptions to existing operations will be permitted except as outlined in this Section. Submit requests at least 2 weeks prior to the beginning of the Work requiring shutdown or interruption. No shutdown shall occur without the approval of the utility company or the Owner.
2. At the pre-construction conference, supply to the Owner the cell phone number of a responsible person who may be contacted during off-hours for emergencies 24 hours a day, seven days a week.
3. Prepare a contact list of phone numbers, including cell phone numbers, and emails for all Project personnel and submit to the Engineer within one week after the pre-construction conference. Include Contractor, Owner, Engineer, and Town personnel including police, fire, and ambulance.

1.3 PROJECT MANAGEMENT

A. Complete the Work in a continuous uninterrupted operation. Use sufficient personnel and adequate equipment to complete the Work within the Contract Time.

1.4 COORDINATION

A. Do not interfere with the operation of the existing facilities.

B. Coordinate with appropriate utility companies, as well as with the Owner, where the Work crosses or is adjacent to existing utilities.

1.5 PROJECT MEETINGS

A. Pre-Construction Conference

1. The Contractor shall be prepared to discuss the following subjects at the Pre-Construction Conference. Documentation for these items is required to be submitted within the time frames included in individual specification sections.

a. Project scheduling

b. Sequencing of critical path Work items

c. Shop Drawing procedures

d. Project changes and clarification procedures

e. Use of sites, access to Work areas, office and storage areas, security and temporary facilities

f. Contractor safety plan and representative

g. Progress payments and procedures

h. Required documentation

i. Project personnel contact list

B. Progress Meetings

1. Progress meetings will be held every 2 weeks and at other times as requested by the Owner or as required by the Progress of the Work.

2. The Contractor's Superintendent shall attend all progress meetings.

3. At a minimum, progress meetings will review Work progress, schedule, Shop Drawing submission schedule, Applications for Payment, and other matters needing discussion and resolution.

4. Review the schedule with all parties to be affected by upcoming work.

5. Review the monthly construction report required under Section 01325.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Notify DIGSAFE at 1-888-344-7233 at least 72 hours prior to any digging, trenching, rock removal, demolition, borings, backfill, grading, landscaping, or any other earth moving operations.

3.2 COORDINATION WITH THE OWNER'S OPERATIONS

A. Notify the Owner and Engineer, in writing, a minimum of 1 week in advance of commencing Work on site.

B. Notify the Owner and Engineer, in writing, a minimum of 1 week before commencing any work which may affect the Owner's operations.

C. Perform all construction activities so as to avoid interference with operations of the facility, the work of others, and compliance with Section 01140, Work Restriction.

D. Coordinate the following operations with the Owner and the Engineer:

1. The Owner will operate all existing facilities. Do not operate any existing equipment without the Owner's approval. The Owner will operate existing facilities or equipment that may be required in order for the Contractor to make connections to existing facilities.

3.3 SEQUENCE OF CONSTRUCTION

A. Constructing the proposed improvements while maintaining existing operations will require a specific sequence of construction. The Contractor will be allowed reasonable flexibility in scheduling the construction activities. Provide a detailed construction schedule as required in Section 01325.

END OF SECTION

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SECTION 01320

CONSTRUCTION PHOTOGRAPHS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Photographs taken at specified intervals before, during and after construction.

1.2 SUBMITTALS

A. Informational Submittals

1. Submit electronic files of each photograph on a CD or USB flash drive.

PART 2 PRODUCTS

2.1 CONSTRUCTION PHOTOGRAPHS

A. Electronic files shall be in .jpg format.

PART 3 EXECUTION

3.1 PRE-CONSTRUCTION PHOTOGRAPHY

A. Prior to the commencement of any Work under this Contract, take a minimum of 2 photographs at 100 foot intervals along the entire access road, of parking areas, dunes, and gatehouse building interior and exterior. The photographs will serve as a record of the original conditions where construction activities will occur.

B. The area to be photographed shall include, but not be limited to, the area within and adjacent to the proposed construction, including roadways, utilities, driveways, landscaping, trees, structures, and buildings.

C. Provide a minimum of 36 preconstruction photographs, or more as required to document the preconstruction condition of the Site and adjacent properties.

3.2 PROGRESS PHOTOGRAPHY

A. Take construction photographs of active work areas at least every week throughout the life of the Contract. The photographs shall be indicative of the work that is currently in progress. A minimum of 3 photographs shall be taken at each scheduled interval at each location where Work is in progress.

B. Take photographs of all utility abandonments.

C. Take photographs of all relocated and new utility connections.

D. Take photographs of all installed infrastructure prior to backfill.

3.3 POST-CONSTRUCTION PHOTOGRAPHY

A. Provide post construction photography after all Work has been completed at each location. The locations to be photographed and the number of photographs required shall be as specified in Paragraph 3.1 for the preconstruction photography.

END OF SECTION

SECTION 01325

SCHEDULING OF CONSTRUCTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Progress Schedule

B. Related Requirements

1. Section 01140 - Work Restrictions

2. Section 01310 - Coordination

1.2 REFERENCES

A. The Use of CPM in Construction - A Manual for General Contractors and the Construction Industry, an Associated General Contractors (AGC) of America publication.

1.3 PROGRESS SCHEDULE

A. Graphically show the order and interdependence of activities, sequence of Work, how the start of a given activity depends on completion of preceding activities, and how completion of an activity may restrain the start of subsequent activities.

B. The Work shall be planned by the Contractor and his Project field superintendent in coordination with all Subcontractors and Suppliers whose Work is shown on the Progress Schedule.

C. Include, at a minimum, the following activities on the Progress Schedule:

1. Project mobilization

2. Submittal and approval of Shop Drawings

3. Procurement of equipment and critical materials

4. Installation of equipment and critical materials

5. Fabrication of special equipment and material, and its installation and testing

6. Final inspecting and testing

7. Punchlist

8. Final cleanup

9. Other activities that may be critical to the Progress Schedule

10. All activities of the Owner and the Engineer which affect progress and/or affect required dates for completion of the Work

D. Take into consideration Shop Drawing submittal and approval time, the delivery times of equipment and materials, Subcontractors' Work, availability and abilities of workmen, weather conditions, any restrictions in operations at the Work site, and all other items that may affect completion of the Work within the Contract.

E. The Progress Schedule shall reflect the requirements and constraints outlined in Section 01310, Coordination.

F. The Progress Schedule shall reflect Work restrictions outlined in Section 01140.

G. Show information in such detail that duration times of activities will range from one to 15 days. The selection and number of activities shall be subject to the approval of the Owner and Engineer.

H. The Progress Schedule should show preceding and following event numbers for each activity, description of each activity, and activity duration in calendar days.

I. Submit the Progress Schedule on maximum sheet size 30-inches high by the width required.

1.4 SUBMITTALS

A. Informational Submittals

1. Submit four prints of the preliminary Progress Schedule. Progress schedule must be submitted within 10 days after the Effective Date of the Agreement. Progress Schedule must be approved by the Owner and Engineer before the first progress payment will be made.

2. Revised analyses - Within 10 days after receipt of the review comments, submit four prints of the Progress Schedule revised in accordance with those comments.

3. Periodic reports - On the first progress meeting of each month, submit four prints of the updated Progress Schedule, as well as a report of construction activities in the prior month.

4. Before initiating the Work, submit an estimated monthly rate of Contractor payments for the project. If the payment schedule deviates from the original projection, submit a revised rate of expenditure schedule.

1.5 PERIODIC REPORTS

A. At the first scheduled progress meeting of each month, present four copies of a construction report which details the Work performed during the preceding period. The report shall include the following at a minimum:

1. Actual progress of Work. Update the Progress Schedule accordingly.

2. The Progress Schedule, or revised Progress Schedule, should show the portions of the Progress Schedule impacted by the Work progress.

3. Activities or portions of activities completed during the reporting period, and their total value as basis for Contractor's periodic request for payment. Payment made will be based on the total value of such activities completed or partially completed after verification by the Engineer.

4. State the percentage of the Work actually completed and scheduled as of the report date, and the progress along the critical path in terms of days ahead of or behind the dates defined in the Progress Schedule.

5. If the Work is behind the dates set forth in the Progress Schedule, also report progress along other paths with negative slack.

6. Include a narrative which includes:

a. A description of problem areas, anticipated and current

b. Delaying factors and their impact

c. An explanation of corrective actions taken or proposed

7. Show the date of latest revision.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Action Submittals

2. Informational Submittals

1.2 DEFINITIONS

A. Action Submittals – includes written and graphic information submitted by Contractor that requires Engineer's approval.

B. Informational Submittals – includes information submitted by Contractor that does not require Engineer's approval. The Engineer will acknowledge receipt of such documents and provide comments when the submittals lack the detail required by the Contract Documents.

1.3 ACTION SUBMITTALS

A. Shop Drawings

1. Shop Drawings as defined in the General Conditions, and as specified in individual work sections include, but are not necessarily limited to, custom-prepared data such as fabrication and erection/installation drawings, schedule information, piece part drawings, actual shop work manufacturing instructions, special wiring diagrams, coordination drawings, individual system or equipment inspection and test reports including performance curves and certification, as applicable to the Work.

2. Shop Drawings shall be of standardized sizes to enable the Owner to maintain a permanent record of the submissions. Approved standard size drawings shall be

a. 24 inches by 36 inches

b. 22 inches by 34 inches

c. 11 inches by 17 inches

d. 8.5 inches by 11 inches

3. Submit Shop Drawings at the proper time to prevent delays in delivery of materials. Coordinate submittals for related or interdependent equipment.

4. Advise the Engineer in writing of any deviations from the requirements of the Contract Documents.

5. Check all Shop Drawings regarding measurements, size of members, materials, and details to determine if they conform to the Contract Documents. Shop Drawings found to be inaccurate, not in compliance, or otherwise in error shall be returned to the Subcontractors or Suppliers for correction before submission to the Engineer. Drawings that are current shall be marked with the date, name, and approval stamp of the Contractor.

6. All details on Shop Drawings submitted for approval shall show clearly the relation of the various parts to the main members and lines of the structure, and where correct fabrication of the work depends upon field measurements, such measurements shall be made and noted on the Shop Drawings before being submitted for approval.

7. Detailed installation drawings (sewers, equipment, piping, electrical conduits and controls, HVAC work, and plumbing, etc.) shall be drawn to scale and fully dimensioned.

8. No material or equipment shall be purchased or fabricated until the required Shop Drawings have been submitted and approved. Materials and equipment and the work involved in their installation or incorporation into the Work shall then be as shown in and represented by the Shop Drawings.

9. Until the necessary approval has been given, do not proceed with any portion of the work, the design or details of which are dependent upon the design or details of work, materials, equipment or other features for which approval is required.

10. If submitted equipment requires modifications to the structures, piping, layout, or other details shown on the Drawings, details of the proposed modifications must also be submitted for approval. If such equipment and modifications are approved, perform all Work necessary to make such modifications at no additional cost to the Owner.

B. Product Data: Product data as specified in individual Sections, include, but are not necessarily limited to, standard prepared data for manufactured products (catalog data), such as the manufacturer's product specification and installation instructions, availability of colors and patterns, manufacturer's printed statements of compliances and applicability, roughing-in diagrams and templates, catalog cuts, product photographs, standard wiring diagrams, printed performance curves and operational-range diagrams, production or quality control inspection and test reports and certifications, mill reports, product operating and maintenance instructions and recommended spare-parts listing, and printed product warranties, as applicable to the Work.

C. Samples and color selection charts: Provide sample, when requested by individual Specification to establish conformance with the Specifications, and as necessary to define color, texture and pattern selections available.

D. Product Substitutions: In accordance with Section 01630.

E. Operation and Maintenance Manuals: In accordance with Section 01770.

F. Schedule of Values: In accordance with Section 01295.

G. Site Usage Plan: In accordance with Section 01140.

1.4 INFORMATIONAL SUBMITTALS

A. Schedule of Submittals

1. Submit a preliminary Schedule of Submittals within 10 days of the Effective Date of the Agreement.

B. Schedule of Manufacturers and Suppliers

1. Submit a schedule of manufacturers and Suppliers within 7 days after Notice to Proceed including the names and addresses of the manufacturers and Suppliers of materials and equipment to be incorporated into the Work.

C. Schedule of Major Products

1. Submit a schedule of major products within 30 days after Notice to Proceed including a complete list of major products proposed for use, with specification section number, name of manufacturer, trade name, and model number of each product.

D. Product Listing and Manufacturers Qualifications

1. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation and reference standards. Specifically identify the products, the anticipated schedule for delivery and storage, and the estimated value thereof for materials which the Contractor intends to request approval for off-site storage.

E. Certificates of Compliance

1. General:

a. Submit sworn certificates from the manufacturer or material supplier that the materials and fabrications provided under the Specification section conform with the Contract Documents.

b. Certificates shall be signed by an officer of the manufacturer's corporation and witnessed by a Notary Public.

2. Welding: Submit in accordance with individual Specification sections.

3. Installer: Prepare written statements on manufacturer's letterhead certifying that installer complies with requirements as specified in individual Specification sections.

4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.

5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency, or when specified in individual Specification sections.

6. Manufacturer's Certificate of Compliance: In accordance with individual Specification sections.

F. Application for Payment

1. Submit applications for payment in accordance with Section 01290, Application and Certificate for Payment.

2. Submit schedule of stored materials when requesting payment for materials not yet installed.

G. Construction Photography and Videography: Provide preconstruction, progress, and post-construction photography in accordance with Sections.

H. Contract Closeout Submittals: In accordance with Section 01770.

I. Contractor Design Data

1. Written and graphic information
2. List of assumptions
3. List of performance and design criteria
4. Summary of loads or load diagram
5. Calculations
6. List of applicable codes and regulations
7. Name and version of software
8. Information requested in individual Specification section

J. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification sections.

K. Schedules - Submit construction progress schedules and schedule updates in accordance with Section 01325.

L. Statement of Qualifications: Submit evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty subcontractor, trade, specialist, consultant, installer, and other professionals.

M. Submittals Required by Laws, Regulations, and Governing Agencies

1. Submit promptly notifications, reports, certifications, payrolls, and other required information as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records, one copy of correspondence and transmittals (including enclosures and attachments) between Contractor and governing agency.

N. Test and Inspection Reports

1. Submit test and inspection reports as required by individual Specification sections.
2. Test and inspection reports shall contain signature of person responsible for test or report.
3. Reports shall include identification of product and Specification, project name, date and time of test, type of test, location, test results, corrective action required if report indicates test is not in compliance with Contract Documents, interpretation of test results, and other information as required in individual Specification sections.

O. Equipment Data: Submit information on equipment to be used in the performance of the Work as required by individual Specification sections.

P. Testing and Start-up Data: Prepare and submit testing procedures proposed to perform testing required by individual Specification sections.

Q. Vendor Training Plan: At least two weeks prior to scheduling training of Owner's personnel, submit lesson plans for vendor training in accordance with individual Specification section and manufacturer's Operations and Maintenance Manuals.

R. Health & Safety Plans: When specified in individual Specification sections, prepare and submit a Health and Safety Plan modified or supplemented to include job-specific considerations.

S. Submittals stamped by another Professional Engineer: When specified in individual Specification sections, prepare and submit calculations and/or drawings stamped by a Professional Engineer licensed in the State where the work is being performed.

T. Coordination Drawings: When specified in individual Specification sections, prepare and submit drawings to show how multiple system and interdisciplinary work will be coordinated. Examples are conduit routing diagrams, duct layouts, utility coordination drawings, sprinkler plans etc.

U. Work Plans: When specified in individual Specification sections, prepare and submit copies of all work plans needed to demonstrate to the Owner that Contractor has adequately thought-out the means and methods of construction and their interface with existing facilities.

V. Erosion Control Plan: When specified in Contract Documents or required by local ordinances or regulations, prepare and submit copies of erosion control plans.

W. Traffic Control Plan: When specified in Contract Documents or required by local ordinances or regulations, prepare and submit copies of traffic control plans.

X. Shutdown Requests: Submit notification of any outages required (electrical, flow processes, etc.) as may be required to tie-in new work into existing facilities. Unless otherwise specified, provide outage requests a minimum of 7 days' notice shall be provided.

Y. Equipment Data: When specified in other Specification sections, information on equipment used by the Contractor to complete the Work, such as compaction equipment and closed-circuit television inspection equipment.

1.5 PROCEDURES

A. Coordination

1. Prepare and submit documentation in advance of fabrication and product manufacturer, so that the installation will not be delayed, other related work can be properly coordinated, and there is adequate time for review and resubmission, if required.

2. Provide no less than 30 days for review of submittals from the time received by the Engineer. For submittals of major equipment, that require more than 30 days to review, due to complexity and detail or those requiring review by multiple engineering disciplines, Engineer will notify Contractor of the circumstances and identify the anticipated date when the submittal will be returned.

3. Re-submittals will be subject to same review time.

4. No extension of time will be authorized due to failure to provide approvable submittals sufficiently in advance of the Work.

B. Review Shop Drawings, product data, and samples prior to submission and verify and determine:

1. Field measurements

2. Conformance with the Contract Documents. Advise the Engineer in writing of any deviations from the requirements of the Contract Documents.

3. Delete or strike out information that is not applicable to the Work.

C. Upload the electronic submittal files via Procore. Access to Procore will be provided by the Engineer. Files must be in .pdf format. The submittals will be returned in electronic .pdf format via Procore.

D. In addition to the electronic submission requirement, submit one hard copies of each submittal for the Owner.

1. Samples – Provide one unless otherwise noted in the individual Specification section. Sample will be retained by Engineer in the field.

E. Numbering: Submissions shall be accompanied by a transmittal form referencing the project name and applicable Specification section. Submittals shall be numbered sequentially, with the applicable Specification section and a hyphen preceding the number. (*e.g.* Submittal number 11330-01). Resubmittals shall bear the same transmittal number with a revision number commencing with "1" (*e.g.* Submittal number 11330-01-1).

F. Provide a copy of the Submittal Certification Form (copy attached at the end of this section) which shall be attached to every copy of each. Apply the Contractor's stamp and initials or signature certifying that the submission has been thoroughly reviewed for completeness, compliance with the Contract Documents, coordination with adjacent construction and dimensional compatibility. Items submitted without the stamp or that are incomplete will be returned by the Engineer for rework and resubmission.

G. Provide a copy of the PE Certification Form (copy attached at the end of this section) which shall be attached to every copy of each submittal stamped by another Professional Engineer. Items submitted without the completed certification form will be returned by the Engineer for resubmission.

H. Distribute copies of reviewed submittals along with the Engineer's transmittal to concerned parties with instructions to promptly report any inability to comply with the provisions or integrate the requirements with interfacing work.

I. Partial and Incomplete Submittals

1. Shop Drawings shall be submitted as a complete package by Specification section, unless otherwise reviewed and approved by the Engineer. It is the intent that all information, materials, and samples associated with each Specification section be included as a single submittal for the Engineer's review.

2. Engineer will return entire submittals if preliminary review deems it incomplete including:

a. Missing or incomplete Submittal Certification Form

b. Insufficient number of copies

c. Missing content

3. Partial submittals may be considered, at Engineer's option, only when necessary to expedite the Project.

4. Partial submittals shall be clearly identified as such on the transmittal to identify missing components.

J. Submittals not required by the Specification will be returned without review or action code.

K. Resubmission

1. Make corrections and modifications required by the Engineer and resubmit until approved.

2. Clearly identify changes made to submittals and indicate other changes that have been made other than those requested by the Engineer.

3. A maximum of two re-submissions of each shop drawing will be reviewed, checked and commented upon without charge to the Contractor (total of 3 submittals). Any additional submissions which are required by the Engineer to fulfill the stipulations of the Contract Documents will be charged to the Contractor.

L. Distribution

1. Distribute approved Shop Drawings and approved product data to the Project Site and elsewhere as required to communicate the information to Suppliers, Subcontractors, and field personnel.

1.6 ENGINEER'S REVIEW

A. The Engineer will review submittals for design, general methods of construction and detailing. The Engineer's review and approval of submittals shall not be construed as a complete check nor does it relieve the Contractor from responsibility for any departures or deviations from the requirements of the Contract Documents unless he has, in writing, called the Engineer's attention to such deviations at the time of submission. It will not extend to means, methods, technique, sequences, or procedures of construction (except where specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto.

B. The Engineer's review of the submittals shall not relieve the Contractor from the responsibility for proper fitting of the Work, or the responsibility of furnishing any work required by the Contract Documents which may not be indicated on the submittals. The Contractor shall be solely responsible for any quantities shown on the submittals.

C. If the Contractor considers any correction indicated on the submittals to constitute a change to the Contract Documents, the Contractor shall provide written notice to the Engineer at least 7 working days prior to release for manufacture.

D. When the submittals have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes therein except upon written instructions from the Engineer.

E. Action submittals as defined in paragraph 1.2 will be reviewed and returned under one of the following codes:

1. Approved (Action Code 1) is assigned when there are no notations or comments on the submittal. Equipment or materials may be released for manufacture, provided that it complies with requirements of the Contract Documents.

2. Approved as Noted (Action Code 2) is assigned when there are notations or comments on the submittal, but the equipment or materials may still be released for manufacture. All notations and comments must be incorporated in the final product. Resubmission is not necessary.

3. Revise and Resubmit (Action Code 3) is assigned when there are notations and comments requiring a resubmittal of the package. Work cannot proceed until the submittal is revised and resubmitted for review.

4. Not Approved (Action Code 4) is assigned when the submittal contains non-specified items or does not meet the requirements of the Contract Documents. It may also be assigned when there is a significant amount of missing material required for the Engineer to perform a complete review. The entire package must be resubmitted, revised to bring the submittal into conformance. It may be necessary to resubmit using a different manufacturer/vendor to meet the requirements of the Contract Documents.

F. Informational submittals as defined in paragraph 1.2 do not require approval by the Engineer. Such submittals will be returned under one of the following codes:

1. Receipt Acknowledged (Action Code 5) is assigned when the submittal is provided for documentation purposes and is acknowledged as received. Comments may be noted using this action code.

2. Revise and Resubmit (Action Code 6) is assigned when there are notations and comments requiring a resubmittal of the package.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SUBMITTAL CERTIFICATION FORM

PROJECT:_____
ENGINEER:_____ ENGINEER'S PROJECT NO.:_____
CONTRACTOR:_____ CONTRACTOR'S PROJECT NO.:_____

TRANSMITTAL NO.:_____ SUBMITTAL NO.:_____
SPECIFICATION NO.:_____ DRAWING NO:_____
DESCRIPTION:_____
MANUFACTURER:_____

The above referenced submittal has been reviewed by the undersigned and I/we certify that the materials and/or equipment meets or exceeds the project specification requirements; that field measurements, dimensions, quantities, specified performance criteria, installation requirements, materials, catalog numbers and related materials have been verified; that all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the work has been determined and verified; that review includes all information related to the contractor's sole responsibility for means, methods, techniques, sequences, and procedures of construction and safety; and item has been coordinated with the overall project with:

NO DEVIATIONS

A COMPLETE LIST OF DEVIATIONS AS FOLLOWS:

_____
_____
_____
_____
_____
_____

SUBMITTED BY:_____ DATE:_____

GENERAL CONTRACTOR'S STAMP

PE CERTIFICATION FORM

The undersigned hereby certifies that he/she is a Professional Engineer registered in the Commonwealth of Massachusetts and that he/she has been employed by _____ to design
(Name of Contractor)

_____
(Insert PE Responsibilities)

In accordance with Specification section _____for the

_____
(Name of Project)

The undersigned further certifies that he/she has performed the said design in conformance with all applicable local, state and federal codes, rules and regulations; and, that his/her signature and PE stamp have been affixed to all calculations and drawings used in, and resulting from, the design.

The undersigned hereby agrees to make all original design drawings and calculations available to the

_____
(Insert Name of Owner)

or Owner's representative within seven days following written request therefor by the Owner.

_____	_____
PE Name	Contractor's Name
_____	_____
Signature	Signature
_____	_____
Title	Title
_____	_____
Address	Address

SECTION 01420

REFERENCES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Standards referenced in the Contract Documents.

1.2 GENERAL

A. Comply with the requirements of standards referenced in the Contract Documents.

1.3 ABBREVIATIONS

A. Abbreviations used in the Specifications are defined as follows:

1. AA – Aluminum Association
2. AABC – Associated Air Balance Council
3. AASHTO – American Association of State Highway and Transportation Officials
4. ACI - American Concrete Institute
5. ACOE - U.S. Army Corps of Engineers
6. ADA – Americans with Disabilities Act
7. AGC – Associated General Contractors of America
8. AGMA - American Gear Manufacturer Association
9. AI – Asphalt Institute
10. AIA – American Institute of Architects
11. AISC – American Institute of Steel Construction
12. AISI - American Iron and Steel Institute
13. AITC - American Institute of Timber Construction
14. AMCA – ANSI – American National Standards Institute
15. APA – American Plywood Association
16. ARI – Air Conditioning and Refrigeration Institute
17. ASCE – American Society of Civil Engineers
18. ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers
19. ASME – American Society of Mechanical Engineers
20. ASTM – American Society for Testing and Materials

21. AWG – American Wire Gauge
22. AWI - Architectural Woodwork Institute
23. AWPA – American Wood Preservers' Association
24. AWS – American Welding Society
25. AWWA – American Water Works Association
26. BIA – Brick Institute of America
27. CLFMI – Chain Link Fence Manufacturer's Institute
28. CPM - Critical Path Method
29. CPVC – Chlorinated Polyvinyl Chloride
30. CRSI – Concrete Reinforcing Steel Institute
31. CI – Cast Iron
32. DEP - Massachusetts Department of Environmental Protection
33. DHI – Door and Hardware Institute
34. DI – Ductile Iron
35. EJCDC – Engineers' Joint Contract Documents Committee
36. EJMA – Expansion Joint Manufacturers Association
37. EPDM – Ethylene Propylene Diene Monomer
38. EPT – Electrical Plastic Tubing
39. FS – Federal Specifications
40. GA – Gypsum Association
41. GFCI – Ground Fault Circuit Interrupter
42. GPS – Global Positioning System
43. HVAC – Heating, Ventilating and Air Conditioning
44. IBC – International Building Code
45. IBR – Institute of Boiler and Radiator Manufacturers
46. ICBO – International Conference of Building Officials
47. IEEE – Institute of Electrical and Electronics Engineers
48. IMI – International Masonry Institute
49. ISA – Instrument Society of America
50. MADEP – Massachusetts Department of Environmental Protection
51. MBMA – Metal Building Manufacturer's Association
52. MEC – Massachusetts Electric Code

53. MGL – Massachusetts General Law
54. MSS – Manufacturer's Standardization Society
55. NAAMM – National Association of Architectural Metal Manufacturers
56. NAVD – North American Vertical Datum
57. NCMA – National Concrete Masonry Association
58. NEC – National Electrical Code
59. NECA – National Electrical Contractors Association
60. NEMA – National Electrical Manufacturers Association
61. NFPA – National Fire Protection Association
62. NRCA – National Roofing Contractors Association
63. NSF – National Sanitation Foundation
64. O&M – Operation and Maintenance
65. OSHA – Occupational Safety and Health Administration
66. PCA – Portland Cement Association
67. PCI – Precast/Prestressed Concrete Institute
68. PS – Product Standard
69. PVC – Polyvinyl Chloride
70. QA/QC – Quality Assurance/Quality Control
71. RCP – Reinforced Concrete Pipe
72. RCSHSB – Red Cedar Shingle and Handsplit Shake Bureau
73. RIS – Redwood Inspection Service
74. RTU – Remote Telemetry Unit
75. SCADA – Supervisory Control and Data Acquisition
76. SDI – Steel Deck Institute
77. UL – Underwriter's Laboratories
78. UPS – Uninterruptable Power Supply
79. USCS – Unified Soil Classification System
80. USDA – United States Department of Agriculture
81. WCLIB – West Coast Lumber Inspection Bureau
82. WOG – Water, Oil, Gas
83. WWPA – Western Wood Products Association

END OF SECTION

SECTION 01520

CONSTRUCTION FACILITIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Temporary sanitary and first-aid facilities

1.2 QUALITY ASSURANCE

A. Maintain temporary construction facilities in proper and safe condition throughout the progress of the Work.

1.3 TEMPORARY SANITARY AND FIRST AID FACILITIES

A. Provide suitably enclosed chemical or self-contained toilets for the use of the labor force employed on the Work. Toilets shall be located near the Work sites and secluded from observation insofar as possible. Toilets shall be serviced weekly, kept clean and supplied throughout the course of the Work.

B. Contractor shall enforce proper use of sanitary facilities.

C. Use of the Owner's sanitary facilities by the Contractor is prohibited.

D. Provide a first aid station at the site.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01570

TEMPORARY CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Dust control
2. Drainage and erosion control
3. Siltation fence – Filter Fabric
4. Erosion Control Barrier – Strawbales/Wattles
5. Mulch
6. Sediment trapping devices

B. Related Requirements

1. Section 01140 – Work Restrictions
2. Section 02925 – Site Restoration

1.2 SUBMITTALS

A. Informational Submittals

1. Storm Water Pollution Prevention Plan (SWPPP)
2. Materials proposed for use in dust control
3. Straw wattles, siltation fence, mulch, and sediment trapping devices

1.3 COMPLIANCE WITH EPA PHASE II STORMWATER PROGRAM

A. The Project involves an overall disturbance of greater than 1 acre and is therefore under jurisdiction of the Environmental Protection Agency's (EPA) Phase II Stormwater Program. Comply with the program in accordance with EPA's 2022 Construction General Permit with subsequent revisions including the following:

1. Prepare a SWPPP and maintain a copy on site throughout construction period. The SWPPP must be kept current and shall be amended according to the conditions described in the permit.
2. Submit a Notice of Intent (NOI) 14 days prior to commencement of earth disturbing work.
3. Post a sign or other notice of permit coverage .
4. Comply with SWPPP including control of stormwater and non-stormwater discharges through use of structural and non-structural best management practices, inspections, maintenance and corrective action activities, spill prevention and emergency response.
5. Submit a Notice of Termination following completion of all construction activities and having met permit requirements for termination.

1.4 COMPLIANCE WITH SPADEFOOT TOAD PROTECTION PLAN

A.

PART 2 PRODUCTS

2.1 SILTATION FENCING - FILTER FABRIC

A. Filter fabric siltation fencing shall be a woven filter fabric having a weight of at least 2.5 ounces per square yard, a thickness of at least 17 mils, a coefficient of permeability of not less than 0.0009 centimeters per second and allows a water flow rate of a minimum 40 gallons per minute per square yard. The material shall have a high sediment filtration capacity, high slurry flow and minimum clogging characteristics. The material shall be equal to FW-300 as manufactured by Mirafi, Inc., Charlotte, North Carolina; Amoco 2130 by Nilex, Inc., Centennial, CO; MISF 180 by Mutual Industries, PA; or equal.

2.2 EROSION CONTROL BARRIER – STRAWBALES/WATTLES

A. Strawbales shall be stake by a minimum of two 1-inch by 1-inch wooden stakes and butt tightly against the adjacent bale.

B. Straw wattles may be used in place of strawbales with prior consultation with the Barnstable Conservation agent and shall be dense 9” diameter tubes, made with certified noxious weed-free straw bound by netting of the type normally used for siltation or erosion control or construction projects.

2.3 SEDIMENT TRAPPING DEVICES

A. Sediment trapping devices shall be Siltsack®, Dandy Bag II®, or equal.

PART 3 EXECUTION

3.1 DUST CONTROL

A. Control dust during the Work. Use a mechanical street sweeper as needed to remove excavated materials from all paved roads and parking areas.

B. Prevent dust from becoming a nuisance or hazard. During construction, excavated material and open or stripped areas are to be policed and controlled to prevent spreading of the material.

C. Control dust during the work on-site using calcium chloride and/or water.

D. During the Work on-site, all paved road and driveway surfaces shall be scraped and broomed free of excavated materials on a daily basis. The surfaces shall be hosed down or otherwise treated to eliminate active or potential dust conditions and the natural road or wearing surface shall be exposed.

E. Ensure that the existing equipment, facilities, and occupied space adjacent to or nearby areas of the work do not come in contact with dust or debris as a result of concrete demolition, excavation or surface preparation for coatings.

F. Control dust by the construction of temporary wooden frame/polyethylene sheeting walls and covering enclosures separating adjacent or nearby areas and equipment from the Work site.

G. Submit for approval materials proposed for use for dust control, prior to start of the Work.

3.2 DRAINAGE AND EROSION CONTROL

A. Control erosion and siltation during the construction through mulching, strawbales, siltation fencing, diversion and control of storm water run-off, ponding areas and similar methods.

B. Provide and maintain sediment trapping systems.

C. Discharge surface runoff from any disturbances to the site into silt containment basins. Utilize siltation prevention measures including strawbale and geotextile fences before discharge to drainage systems.

D. Install sediment trapping devices in catch basins located in existing paved areas with sediment trapping devices to minimize the transport of sediment through the subsurface stormwater collection system.

3.3 STRAWBALES / STRAW WATTLES AND SILTATION FENCE

A. Place and maintain strawbales / straw wattles and a staked filter fabric siltation fence along the entire length of the proposed construction between the area of construction and surrounding wetlands where shown on the Drawings or required by permit.

B. Install strawbales / straw wattles by anchoring to existing ground with wood stake at 4-feet on center. The stake shall be a minimum of 1-inch square cross section and shall be long enough to penetrate 12 inches into the ground. Replace deteriorated straw wattles. Remove and dispose of the straw wattles following the successful growth of vegetation in the areas disturbed by the construction. Strawbales shall not be removed until their removal is approved by the Engineer.

C. Install a filter fabric siltation fence in addition to the staked strawbales, prior to construction and remove after full surface restoration has been achieved. Install the siltation fence parallel and immediately adjacent to the strawbales as shown on the Drawings. Install as follows:

1. Hand shovel excavate a small trench on the upstream side of the desired fence line location.

2. Unroll the siltation fence system, position the post in the back of the trench (downhill side), and hammer the post at least 1½ feet into the ground.

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

4. Backfill the trench and compact.

D. Perform work in accordance with Town Barnstable Conservation Commission Order of Conditions.

3.4 TEMPORARY RESTORATION

A. Provide erosion control and netting for surface restoration of areas disturbed during construction activities.

B. Provide temporary stabilization of disturbed areas that remain inactive greater than 14 consecutive days to minimize erosion. Methods to minimize erosion may include but are not limited to:

1. Installing jute netting.

2. Preparing surfaces to increase the runoff flow path, reduce the runoff flow velocity, or create small storage pockets to retain surface flows. Methods of accomplishing this include using mechanical devices such as track equipment or sheep's foot rollers.

C. Restore the ground surface in brush and/or woodland areas by machine spreading of existing stripped surface soils as well as installing jute netting where required by steep slopes.

D. Salvage existing surface material and stockpile this material for re-spreading where originally removed. On backfilling, grading shall be returned to preconstruction contours and the stockpile of loam shall be spread over areas disturbed during construction activities.

E. Place mulch on seeded areas. Use jute netting on areas having a slope greater than 3 horizontal to 1 vertical, to anchor the mulch until a satisfactory growth is obtained. If seeding is not possible because of the time of the year, apply mulch and netting to stabilize the area until such time as seed can be sown.

F. Provide grading, and/or netting to maintain the restored areas until the Work is accepted by the Owner.

3.5 CLEANING

A. Remove any sediment that builds up around the strawbales, catchbasins, vegetative swales, forebays, and stormwater basins.

B. Clean sediment trapping devices periodically during the Work. Devices shall be cleaned on a weekly basis, or more frequently if the devices become clogged.

C. Clean catchbasins that collect sediment as a result of the Work.

END OF SECTION

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SECTION 01630

PRODUCT SUBSTITUTION DURING CONSTRUCTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Product substitution procedures

1.2 CONTRACTOR'S OPTIONS

A. For materials or equipment (hereinafter products) specified only by performance or reference standard, select product meeting that standard, by any Supplier. To the maximum extent possible, provide products of the same generic kind from a single source.

B. For products specified by naming several products or manufacturers, select any one of the products or Suppliers named, which fully complies with the Drawings and Specifications. Another “or-equal” product can also be considered by the Engineer if it complies with the provisions of Section 2, Instructions to Bidders, Subsection 11. If a product proposed by the Contractor does not qualify as an “or-equal” item, then it can be considered as a proposed substitute item, and the Contractor must comply with the requirements of Section 2, Instructions to Bidders, Subsection 11

C. For products specified by naming products or manufacturers and followed by words indicating that no “or-equal” item or substitution is permitted, there is no option and no substitution will be allowed.

D. Where more than one choice is available as a Contractor's option, select product that is compatible with other products already selected or specified.

1.3 SUBSTITUTIONS

A. If in the Engineer’s sole discretion a product proposed by the Contractor does not qualify as an “or-equal” item under the provisions of Section 2 Instructions to Bidders, Subsection 11, it can be considered a proposed substitute item. Submit information required under Section 2 Instructions to Bidders, Subsection 11 for proposed substitutes.

B. The Engineer will consider written requests from the Contractor for substitutions within 30 days after the Notice to Proceed. After this period, requests will be considered only in case of unavailability of product or other conditions beyond control of the Contractor.

C. Submit 5 copies of request for substitutions. Submit a separate request for each proposed substitution. In addition to the submittal requirements outlined in Section 2 Instructions to Bidders, Subsection 11, include the following in each substitution request:

1. For products or Suppliers:

a. Product identification, including Supplier & manufacturer's name and address.

b. Manufacturer's literature with product description, performance and test data, and reference standards.

c. Samples, if appropriate.

d. Name and address of similar projects on which product was used, and date of installation.

2. For construction methods (if specified):

a. Detailed description of proposed method.

b. Drawings illustrating method.

3. Such other data as the Engineer may require to establish that the proposed substitution is equal to the product, Supplier or method specified.

D. The substitution request shall include written certification and statements that are outlined in Section 2 Instructions to Bidders, Subsection 11.

E. A request constitutes a representation that Contractor:

1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.

2. Will provide same or better guarantees, warranties or bonds for proposed substitution as for specified product.

3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.

4. Waives all claims for additional costs or time extension which may subsequently become apparent.

5. Will reimburse Owner for review or redesign services associated with re-approval by authorities having jurisdiction.

F. A proposed substitution will not be accepted if:

1. Acceptance will require changes in the design concept or a substantial revision of the Contract Documents.

2. It will delay completion of the Work.

3. It is intended or implied on a Shop Drawing and is not accompanied by a formal request for substitution from the Contractor.

G. The Contractor is responsible for all costs relating to substitution requests.

H. Approval of a substitution does not relieve the Contractor from the requirement for submission of Shop Drawings as set forth in the Contract Documents.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION – NOT USED

END OF SECTION

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SECTION 01770

CLOSEOUT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Documentation required for the transfer of the completed Work to the Owner

2. Final Cleaning

1.2 SUBMITTALS

A. Closeout Submittals

1. As-built drawings

2. Operation and maintenance manuals

3. Evidence of payment and release of liens

4. List of Subcontractors, service organizations, and principal vendors

1.3 SUBSTANTIAL COMPLETION

A. Refer to Article 12.7 in General Conditions, for procedures relating to obtaining Substantial Completion. Refer to General Conditions and Agreement, for Contract Times.

1.4 PROJECT CLOSEOUT DOCUMENTS

A. As-Built Drawings - Submit draft as-built drawings in both electronic AutoCAD (v2021 compatible) and hard copy format for review, approval, or comment. The as-built drawings shall show the completed work, including all deviations from the original Drawings. As-built drawings shall depict the location of all piping and valves installed under this Contract, as well as field changes. Take swing ties to all underground work from a minimum of two horizontal locations. Vertical dimensions (to all below grade work shall also be obtained. All fittings, bends, valves and other appurtenances shall be shown. At a minimum, the following information shall be shown on the as-built drawings.

1. Ties to all buried fittings (including tees, crosses, bends, reducers, wyes, offsets, adapters, sleeves, caps, plugs), valves, services and structures from two horizontal measurements to permanent surface reference points, and depth below permanent grade. Permanent surface reference points are manholes, catch basins, power poles, and above-grade structures.

2. Ties to all surface structures (including manholes, catch basins, vaults, valve boxes, hydrants, curb stops, cleanouts, wet wells, outlets, etc.) from two horizontal measurements to permanent surface reference points. Re-station surface structures if stationed on Drawings.

3. Ties to other utility crossings, abandoned pipelines, and sewer service stubs, from two horizontal measurements to permanent surface reference points include depth below permanent grade and spacing between crossing utilities.

4. Invert and rim elevation of all gravity pipelines and structures including manholes, catch basins, below-grade structures, wet wells, septic tanks and distribution boxes as appropriate.

5. Depth of ledge at changes in profile but not more than 25-foot intervals.

6. Changes to pipe size and materials.

B. Final As-Built Drawings

1. Update draft copy of as-built drawings with review comments from the Owner and Engineer.

2. Provide final as-built drawings in both electronic AutoCAD (v2021 compatible) and hard copy format.

C. Operation and Maintenance manuals - Provide four copies of operation and maintenance manuals for each type of equipment provided on the project. Manuals shall include as a minimum:

1. The Operations and Maintenance Manual Certification Form (copy attached at the end of this Section) which shall be attached to every copy of each Operations and Maintenance Manual submitted.

2. Detailed service, maintenance and operation instructions for each item supplied

3. Special maintenance requirements, along with special calibration and test procedures

4. Operating instructions

5. Preventative maintenance instructions

6. Corrective-maintenance instructions

7. Complete parts lists with stock numbers and name, address, and telephone number of the local supplier

D. Provide warranties and bonds for items so listed in pertinent sections of the Project Manual.

E. Provide evidence of compliance with requirements of governmental agencies having jurisdiction.

F. As specified in Section 12 Application and Certification of Payment, provide evidence that all Work, materials and equipment will pass to Owner free and clear of any Liens or other title defects upon final payment. Such evidence may take the form of receipts or releases from all Subcontractors and Suppliers and an affidavit from Contractor as to the completeness of the receipts and releases as described in Section 12.

G. Provide list of Subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service at all times including nights, weekends, and holidays.

1.5 FINAL PAYMENT

A. Refer to Article 12, Payments and Completion for procedures relating to final inspection and payment.

B. The Contract shall be considered complete and final payment made, only when:

1. All provisions of the Contract Documents have been strictly adhered to.

2. The project and premises have been left in good order, including removal of all temporary construction, Contractor-owned and extraneous materials.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 CLEANING

A. Remove and entirely dispose of material or debris that has washed, flowed or has been placed in existing watercourses, ditches, gutters, drains, pipe, or structures, for work done under the Contract work limits. Leave ditches, channels, drains, pipes, structures, and watercourses in a clean and neat condition upon completion of the Work.

B. Restore or replace any public or private property damaged or removed during the course of the Work. Property shall be returned to a condition at least equal to that existing immediately prior to the beginning of operations. Complete all highway or driveway, walk, and landscaping work using suitable materials, equipment and methods. Perform restoration of existing property, signs or structures promptly as work progresses; do not leave restoration work until the end of the Contract Time.

END OF SECTION

J: \B\B0633 Barnstable\008 - FY22 Sandy Neck Beach Facility Reconfiguration\Design\Specifications\Div 1\01770 - Closeout Procedures.docx

O&M MANUAL CERTIFICATION FORM

PROJECT:_____
ENGINEER:_____ ENGINEER'S PROJECT NO.:_____
CONTRACTOR:_____ CONTRACTOR'S PROJECT NO.:_____

TRANSMITTAL NO.:_____ SHOP DRAWING NO.:_____
SPECIFICATION NO.:_____ DRAWING NO:_____
DESCRIPTION:_____
MANUFACTURER:_____

The above referenced O&M manual has been reviewed by the undersigned and I/we certify that the manual is customized as needed for this project, and contains the following items, where applicable for the materials or equipment provided:

3-ring binder with title on binder and binding edge	Complete parts list of equipment supplied
Electronic CD, when specified	Complete specifications/data on each item
Comprehensive index broken down into sections	Detailed maintenance & operations instructions
Dividers for sections and sub-sections	"As constructed" layout & schematic drawings
Warranties	Wiring diagrams
Troubleshooting information	Lubrication & maintenance schedules
Startup, operation & shutdown procedures	Equipment performance curves
Safety procedures	List of spare parts supplied and current cost
Manufacturer's contact information	Parts & service contact information

SUBMITTED BY:_____ DATE:_____

GENERAL CONTRACTOR'S STAMP

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
SE3-6179
MassDEP File #

eDEP Transaction #

Barnstable
City/Town

A. General Information

Please note: this form has been modified with added space to accommodate the Registry of Deeds Requirements

1. From: Barnstable
Conservation Commission

2. This issuance is for (check one): a. ☒ Order of Conditions b. ☐ Amended Order of Conditions

3. To: Applicant:

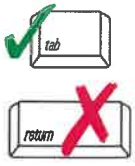
a. First Name | b. Last Name

Town of Barnstable - Marine & Environmental Affairs
c. Organization

367 Main Street
d. Mailing Address

Hyannis | MA | 02601
e. City/Town | f. State | g. Zip Code

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.



4. Property Owner (if different from applicant):

a. First Name | b. Last Name

c. Organization

d. Mailing Address

e. City/Town | f. State | g. Zip Code

5. Project Location:

425 Sandy Neck Road
a. Street Address

West Barnstable
b. City/Town

263
c. Assessors Map/Plat Number

001
d. Parcel/Lot Number

Latitude and Longitude, if known: 40.738822 N (d. Latitude) 70.381086 W (e. Longitude)

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 5 – Order of Conditions
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP: SE3-6179
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Barnstable
City/Town

A. General Information (cont.)

6. Property recorded at the Registry of Deeds for (attach additional information if more than one parcel):

Barnstable
a. County

LAND SHOWN ON LAND COURT PLAN NO. 14099A
LC CERTIFICATE NO. 121665
b. Certificate Number (if registered land)

~~358~~ 6685
c. Book

~~377~~ 179
d. Page

7. Dates: 04/02/2024 a. Date Notice of Intent Filed; 04/16/2024 b. Date Public Hearing Closed; 05/16/2024 c. Date of Issuance

8. Final Approved Plans and Other Documents (attach additional plan or document references as needed):

Town of Barnstable Sandy Neck Beach Facility Reconfiguration (43 sheets)
a. Plan Title

Tighe & Bond
b. Prepared By

Brian S. Huntley, P.E. and Daniel J. Boulais, P.E.

07/27/2023
d. Final Revision Date

Various
e. Scale

f. Additional Plan or Document Title

g. Date

B. Findings

1. Findings pursuant to the Massachusetts Wetlands Protection Act:

Following the review of the above-referenced Notice of Intent and based on the information provided in this application and presented at the public hearing, this Commission finds that the areas in which work is proposed is significant to the following interests of the Wetlands Protection Act (the Act). Check all that apply:

a. ☐ Public Water Supply b. ☐ Land Containing Shellfish c. ☒ Prevention of Pollution
d. ☐ Private Water Supply e. ☐ Fisheries f. ☒ Protection of Wildlife Habitat
g. ☐ Groundwater Supply h. ☒ Storm Damage Prevention i. ☒ Flood Control

2. This Commission hereby finds the project, as proposed, is: (check one of the following boxes)

Approved subject to:

a. ☒ the following conditions which are necessary in accordance with the performance standards set forth in the wetlands regulations. This Commission orders that all work shall be performed in accordance with the Notice of Intent referenced above, the following General Conditions, and any other special conditions attached to this Order. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, these conditions shall control.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
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Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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B. Findings (cont.)

Denied because:

b. ☐ the proposed work cannot be conditioned to meet the performance standards set forth in the wetland regulations. Therefore, work on this project may not go forward unless and until a new Notice of Intent is submitted which provides measures which are adequate to protect the interests of the Act, and a final Order of Conditions is issued. **A description of the performance standards which the proposed work cannot meet is attached to this Order.**

c. ☐ the information submitted by the applicant is not sufficient to describe the site, the work, or the effect of the work on the interests identified in the Wetlands Protection Act. Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides sufficient information and includes measures which are adequate to protect the Act's interests, and a final Order of Conditions is issued. **A description of the specific information which is lacking and why it is necessary is attached to this Order as per 310 CMR 10.05(6)(c).**

3. ☐ Buffer Zone Impacts: Shortest distance between limit of project disturbance and the wetland resource area specified in 310 CMR 10.02(1)(a) — a. linear feet

Inland Resource Area Impacts: Check all that apply below. (For Approvals Only)

Resource Area	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
4. ☐ Bank	a. linear feet	b. linear feet	c. linear feet	d. linear feet
5. ☐ Bordering Vegetated Wetland	a. square feet	b. square feet	c. square feet	d. square feet
6. ☐ Land Under Waterbodies and Waterways	a. square feet	b. square feet	c. square feet	d. square feet
	e. c/y dredged	f. c/y dredged		
7. ☐ Bordering Land Subject to Flooding	a. square feet	b. square feet	c. square feet	d. square feet
Cubic Feet Flood Storage	e. cubic feet	f. cubic feet	g. cubic feet	h. cubic feet
8. ☐ Isolated Land Subject to Flooding	a. square feet	b. square feet		
Cubic Feet Flood Storage	c. cubic feet	d. cubic feet	e. cubic feet	f. cubic feet
9. ☐ Riverfront Area	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

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B. Findings (cont.)

Coastal Resource Area Impacts: Check all that apply below. (For Approvals Only)

	Proposed Alteration	Permitted Alteration	Proposed Replacement	Permitted Replacement
10. ☐ Designated Port Areas	Indicate size under Land Under the Ocean, below			
11. ☐ Land Under the Ocean	a. square feet c. c/y dredged	b. square feet d. c/y dredged		
12. ☒ Barrier Beaches	Indicate size under Coastal Beaches and/or Coastal Dunes below			
13. ☒ Coastal Beaches	18,330 (temp) a. square feet	b. square feet	cu yd c. nourishment	cu yd d. nourishment
14. ☒ Coastal Dunes	168,577 (temp) 207,346 (perm) a. square feet	b. square feet	cu yd c. nourishment	cu yd d. nourishment
15. ☐ Coastal Banks	a. linear feet	b. linear feet		
16. ☐ Rocky Intertidal Shores	a. square feet	b. square feet		
17. ☐ Salt Marshes	a. square feet	b. square feet	c. square feet	d. square feet
18. ☐ Land Under Salt Ponds	a. square feet c. c/y dredged	b. square feet d. c/y dredged		
19. ☐ Land Containing Shellfish	a. square feet	b. square feet	c. square feet	d. square feet
20. ☐ Fish Runs	Indicate size under Coastal Banks, Inland Bank, Land Under the Ocean, and/or inland Land Under Waterbodies and Waterways, above			
21. ☒ Land Subject to Coastal Storm Flowage	a. c/y dredged 186,907 (temp) 207,346 (perm) a. square feet	b. c/y dredged b. square feet		
22. ☐ Riverfront Area	a. total sq. feet	b. total sq. feet		
Sq ft within 100 ft	c. square feet	d. square feet	e. square feet	f. square feet
Sq ft between 100-200 ft	g. square feet	h. square feet	i. square feet	j. square feet

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B. Findings (cont.)

*** #23.** If the project is for the purpose of restoring or enhancing a wetland resource area in addition to the square footage that has been entered in Section B.5.c (BVW) or B.17.c (Salt Marsh) above, please enter the additional amount here.

23. ☐ Restoration/Enhancement *:

a. square feet of BVW | b. square feet of salt marsh

24. ☐ Stream Crossing(s):

a. number of new stream crossings | b. number of replacement stream crossings

C. General Conditions Under Massachusetts Wetlands Protection Act

The following conditions are only applicable to Approved projects.

1. Failure to comply with all conditions stated herein, and with all related statutes and other regulatory measures, shall be deemed cause to revoke or modify this Order.
2. The Order does not grant any property rights or any exclusive privileges; it does not authorize any injury to private property or invasion of private rights.
3. This Order does not relieve the permittee or any other person of the necessity of complying with all other applicable federal, state, or local statutes, ordinances, bylaws, or regulations.
4. The work authorized hereunder shall be completed within three years from the date of this Order unless either of the following apply:
   a. The work is a maintenance dredging project as provided for in the Act; or
   b. The time for completion has been extended to a specified date more than three years, but less than five years, from the date of issuance. If this Order is intended to be valid for more than three years, the extension date and the special circumstances warranting the extended time period are set forth as a special condition in this Order.
   c. If the work is for a Test Project, this Order of Conditions shall be valid for no more than one year.
5. This Order may be extended by the issuing authority for one or more periods of up to three years each upon application to the issuing authority at least 30 days prior to the expiration date of the Order. An Order of Conditions for a Test Project may be extended for one additional year only upon written application by the applicant, subject to the provisions of 310 CMR 10.05(11)(f).
6. If this Order constitutes an Amended Order of Conditions, this Amended Order of Conditions does not extend the issuance date of the original Final Order of Conditions and the Order will expire on 05/16/2027 unless extended in writing by the Department.
7. Any fill used in connection with this project shall be clean fill. Any fill shall contain no trash, refuse, rubbish, or debris, including but not limited to lumber, bricks, plaster, wire, lath, paper, cardboard, pipe, tires, ashes, refrigerators, motor vehicles, or parts of any of the foregoing.

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C. General Conditions Under Massachusetts Wetlands Protection Act

8. This Order is not final until all administrative appeal periods from this Order have elapsed, or if such an appeal has been taken, until all proceedings before the Department have been completed.

9. No work shall be undertaken until the Order has become final and then has been recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land upon which the proposed work is to be done. In the case of the registered land, the Final Order shall also be noted on the Land Court Certificate of Title of the owner of the land upon which the proposed work is done. The recording information shall be submitted to the Conservation Commission on the form at the end of this Order, which form must be stamped by the Registry of Deeds, prior to the commencement of work.

10. A sign shall be displayed at the site not less then two square feet or more than three square feet in size bearing the words,

"Massachusetts Department of Environmental Protection" [or, "MassDEP"]

"File Number SE3-6179 "

11. Where the Department of Environmental Protection is requested to issue a Superseding Order, the Conservation Commission shall be a party to all agency proceedings and hearings before MassDEP.

12. Upon completion of the work described herein, the applicant shall submit a Request for Certificate of Compliance (WPA Form 8A) to the Conservation Commission.

13. The work shall conform to the plans and special conditions referenced in this order.

14. Any change to the plans identified in Condition #13 above shall require the applicant to inquire of the Conservation Commission in writing whether the change is significant enough to require the filing of a new Notice of Intent.

15. The Agent or members of the Conservation Commission and the Department of Environmental Protection shall have the right to enter and inspect the area subject to this Order at reasonable hours to evaluate compliance with the conditions stated in this Order, and may require the submittal of any data deemed necessary by the Conservation Commission or Department for that evaluation.

16. This Order of Conditions shall apply to any successor in interest or successor in control of the property subject to this Order and to any contractor or other person performing work conditioned by this Order.

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

17. Prior to the start of work, and if the project involves work adjacent to a Bordering Vegetated Wetland, the boundary of the wetland in the vicinity of the proposed work area shall be marked by wooden stakes or flagging. Once in place, the wetland boundary markers shall be maintained until a Certificate of Compliance has been issued by the Conservation Commission.

18. All sedimentation barriers shall be maintained in good repair until all disturbed areas have been fully stabilized with vegetation or other means. At no time shall sediments be deposited in a wetland or water body. During construction, the applicant or his/her designee shall inspect the erosion controls on a daily basis and shall remove accumulated sediments as needed. The applicant shall immediately control any erosion problems that occur at the site and shall also immediately notify the Conservation Commission, which reserves the right to require additional erosion and/or damage prevention controls it may deem necessary. Sedimentation barriers shall serve as the limit of work unless another limit of work line has been approved by this Order.

19. The work associated with this Order (the "Project")
    (1) ☒ is subject to the Massachusetts Stormwater Standards
    (2) ☐ is NOT subject to the Massachusetts Stormwater Standards

    If the work is subject to the Stormwater Standards, then the project is subject to the following conditions:

    a) All work, including site preparation, land disturbance, construction and redevelopment, shall be implemented in accordance with the construction period pollution prevention and erosion and sedimentation control plan and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Construction General Permit as required by Stormwater Condition 8. Construction period erosion, sedimentation and pollution control measures and best management practices (BMPs) shall remain in place until the site is fully stabilized.

    b) No stormwater runoff may be discharged to the post-construction stormwater BMPs unless and until a Registered Professional Engineer provides a Certification that:

    i. all construction period BMPs have been removed or will be removed by a date certain specified in the Certification. For any construction period BMPs intended to be converted to post construction operation for stormwater attenuation, recharge, and/or treatment, the conversion is allowed by the MassDEP Stormwater Handbook BMP specifications and that the BMP has been properly cleaned or prepared for post construction operation, including removal of all construction period sediment trapped in inlet and outlet control structures;

    ii. as-built final construction BMP plans are included, signed and stamped by a Registered Professional Engineer, certifying the site is fully stabilized;

    iii. any illicit discharges to the stormwater management system have been removed, as per the requirements of Stormwater Standard 10;

C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

iv. all post-construction stormwater BMPs are installed in accordance with the plans (including all planting plans) approved by the issuing authority, and have been inspected to ensure that they are not damaged and that they are in proper working condition;

v. any vegetation associated with post-construction BMPs is suitably established to withstand erosion.

c) The landowner is responsible for BMP maintenance until the issuing authority is notified that another party has legally assumed responsibility for BMP maintenance. Prior to requesting a Certificate of Compliance, or Partial Certificate of Compliance, the responsible party (defined in General Condition 18(e)) shall execute and submit to the issuing authority an Operation and Maintenance Compliance Statement ("O&M Statement) for the Stormwater BMPs identifying the party responsible for implementing the stormwater BMP Operation and Maintenance Plan ("O&M Plan") and certifying the following:

i.) the O&M Plan is complete and will be implemented upon receipt of the Certificate of Compliance, and

ii.) the future responsible parties shall be notified in writing of their ongoing legal responsibility to operate and maintain the stormwater management BMPs and implement the Stormwater Pollution Prevention Plan.

d) Post-construction pollution prevention and source control shall be implemented in accordance with the long-term pollution prevention plan section of the approved Stormwater Report and, if applicable, the Stormwater Pollution Prevention Plan required by the National Pollution Discharge Elimination System Multi-Sector General Permit.

e) Unless and until another party accepts responsibility, the landowner, or owner of any drainage easement, assumes responsibility for maintaining each BMP. To overcome this presumption, the landowner of the property must submit to the issuing authority a legally binding agreement of record, acceptable to the issuing authority, evidencing that another entity has accepted responsibility for maintaining the BMP, and that the proposed responsible party shall be treated as a permittee for purposes of implementing the requirements of Conditions 18(f) through 18(k) with respect to that BMP. Any failure of the proposed responsible party to implement the requirements of Conditions 18(f) through 18(k) with respect to that BMP shall be a violation of the Order of Conditions or Certificate of Compliance. In the case of stormwater BMPs that are serving more than one lot, the legally binding agreement shall also identify the lots that will be serviced by the stormwater BMPs. A plan and easement deed that grants the responsible party access to perform the required operation and maintenance must be submitted along with the legally binding agreement.

f) The responsible party shall operate and maintain all stormwater BMPs in accordance with the design plans, the O&M Plan, and the requirements of the Massachusetts Stormwater Handbook.

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C. General Conditions Under Massachusetts Wetlands Protection Act (cont.)

g) The responsible party shall:
1. Maintain an operation and maintenance log for the last three (3) consecutive calendar years of inspections, repairs, maintenance and/or replacement of the stormwater management system or any part thereof, and disposal (for disposal the log shall indicate the type of material and the disposal location);
2. Make the maintenance log available to MassDEP and the Conservation Commission ("Commission") upon request; and
3. Allow members and agents of the MassDEP and the Commission to enter and inspect the site to evaluate and ensure that the responsible party is in compliance with the requirements for each BMP established in the O&M Plan approved by the issuing authority.

h) All sediment or other contaminants removed from stormwater BMPs shall be disposed of in accordance with all applicable federal, state, and local laws and regulations.

i) Illicit discharges to the stormwater management system as defined in 310 CMR 10.04 are prohibited.

j) The stormwater management system approved in the Order of Conditions shall not be changed without the prior written approval of the issuing authority.

k) Areas designated as qualifying pervious areas for the purpose of the Low Impact Site Design Credit (as defined in the MassDEP Stormwater Handbook, Volume 3, Chapter 1, Low Impact Development Site Design Credits) shall not be altered without the prior written approval of the issuing authority.

l) Access for maintenance, repair, and/or replacement of BMPs shall not be withheld. Any fencing constructed around stormwater BMPs shall include access gates and shall be at least six inches above grade to allow for wildlife passage.

Special Conditions (if you need more space for additional conditions, please attach a text document):

20. For Test Projects subject to 310 CMR 10.05(11), the applicant shall also implement the monitoring plan and the restoration plan submitted with the Notice of Intent. If the conservation commission or Department determines that the Test Project threatens the public health, safety or the environment, the applicant shall implement the removal plan submitted with the Notice of Intent or modify the project as directed by the conservation commission or the Department.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 5 – Order of Conditions
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
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Barnstable
City/Town

D. Findings Under Municipal Wetlands Bylaw or Ordinance

1. Is a municipal wetlands bylaw or ordinance applicable? ☒ Yes ☐ No

2. The Barnstable Conservation Commission hereby finds (check one that applies):

   a. ☐ that the proposed work cannot be conditioned to meet the standards set forth in a municipal ordinance or bylaw, specifically:

   1. Municipal Ordinance or Bylaw | 2. Citation

   Therefore, work on this project may not go forward unless and until a revised Notice of Intent is submitted which provides measures which are adequate to meet these standards, and a final Order of Conditions is issued.

   b. ☒ that the following additional conditions are necessary to comply with a municipal ordinance or bylaw:

   Barnstable (1. Municipal Ordinance or Bylaw) | S.237-1 - 237-14

3. The Commission orders that all work shall be performed in accordance with the following conditions and with the Notice of Intent referenced above. To the extent that the following conditions modify or differ from the plans, specifications, or other proposals submitted with the Notice of Intent, the conditions shall control.

   The special conditions relating to municipal ordinance or bylaw are as follows (if you need more space for additional conditions, attach a text document):

   See pages 10.1, 10.2, 10.3 and NHESP letter dated 04/30/2024 attached.

SE3-6179

Name: Town of Barnstable – Marine and Environmental Affairs

Approved Plan = Complete set of plans (43 sheets) dated 7/27/2023 by Brian S. Huntley, P.E. and Daniel J. Boulais, P.E.

Special Conditions of Approval

I. Preface

Caution: Failure to comply with all Conditions of this Order of Conditions may have serious consequences. Consequences may include: issuance of a Stop Work Order; fines; requirement to remove un-permitted structures; requirement to re-landscape to original condition; inability to obtain a Certificate of Compliance, and more. The General Conditions of this Order begin on Page 5 and continue through Page 9. The Special Conditions contained herein and all Conditions require your compliance.

II. Prior to the start of work, the following conditions shall be satisfied:

1. Within one month of receipt of this Order of Conditions and prior to the commencement of any work approved herein, General Condition Number 9 (recording requirement) shall be complied with.
2. It is the responsibility of the applicant, the owner and/or successor(s) and the project contractors to ensure that all conditions of this Order are complied with. The applicant shall provide copies of the Order of Conditions and approved plans (and any approved revisions thereof) to project contractors prior to the start of work. Barnstable Conservation Commission Forms A and B shall be completed and returned to the Commission Commission prior to the start of work.
3. General Condition Number 10 (sign requirement) shall be complied with.
4. The Conservation Commission shall receive written notice one (1) week in advance of the start of work.
5. The work-limit line shown on the approved plan shall be staked in the field by the project surveyor/engineer.
6. Staked strawbales backed by trenched-in siltation fencing shall be set along the approved work-limit line. Wattles may be used instead, following consultation with the Conservation Agent. Where authorized for use, wattles shall be 8" in height at the minimum. Effective sediment controls shall remain until the site is stabilized with vegetation, then they shall be removed.
7. A sequence of color photographs showing the undisturbed buffer zone shall be submitted to the Conservation Commission. Note: The strawbales and siltation fence (or wattles, where approved) must show in the foreground (or bottom) of the photographs.

III. The following additional Conditions shall govern the project once work begins. Note, especially, Special Condition Number 15, requiring verification of the locations of the foundation and strawbale line.

8. General Conditions, Numbers 13 and 14 (changes in plan) shall be complied with.
9. General Condition Number 18 (maintaining sediment controls) shall be complied with.
10. The work limit shown on the approved plan shall be strictly observed.
11. There shall be no disturbance of the site, including cutting of vegetation, beyond the work limit. **This condition shall continue over time.** The only exception would be those disturbances with specific prior approval.
12. The Conservation Commission, its employees and its agents shall have a right of entry to inspect for compliance the provisions of this Order of Conditions.
13. Unless extended, this permit is valid for three years from the date of issuance.
14. An Amended Order does not change the original date of expiration of this Order of Conditions.
15. Upon completion of the relocated gatehouse, parking lot, access roads, and paths the project surveyor or engineer shall verify in writing or by plan to the Commission the correct location and work-limit line and note any discrepancies from the approved plan. If verification is in the form of an "as-built" plan, the plan provided shall be drawn at the same scale as the approved plan.
16. Time of year restriction - work located upon the coastal beach and seaward face of the dune (including dune restoration) shall not occur during the shorebird breeding period, April 1 through August 31.
17. See NHESP letter dated 4/30/2024 attached for additional listed conditions.
18. The Engineer should ensure that the bottom of the leaching basins should be at least two feet above the seasonal high groundwater table.
19. For information only, the Town agrees to monitor and report the total phosphorus and total nitrogen removal of the stormwater systems for three years after the stormwater systems are constructed.
20. The Town shall be responsible for implementing the long-term pollution prevention and stormwater management system operation and maintenance plan.
21. Under a valid order of conditions, up to 4,000 cubic yards of dune nourishment with compatible sand will be allowed if needed, with documentation submitted to Conservation Administrator documenting storm damage and protocol for access.
22. A copy of the Conservation management Plan and permit shall be submitted for the record.
23. A copy of the Conservation Restriction (CR), approved by the Town Attorney, shall be submitted for the record.

24. The required planting will be supervised by Chief Ranger, Nina Coleman. Americorp, Upper Cape Tech students, and scouts can assist with plantings.

25. Monitoring reports for mitigation/restoration area shall be submitted by Chief Ranger once annually for a period of three years. Reports may commence after a growing season.

26. Work limit markers (wood stakes) shall remain in place until a Certificate of Compliance is issued for this project.

IV. After all work is completed, the following condition must be promptly met:

27. At the completion of work, or by the expiration of this Order, the applicant shall request in writing a Certificate of Compliance for the work herein permitted. Barnstable Conservation Commission Form C shall be completed and returned, along with the request for a Certificate of Compliance and appropriate fee. Where a project has been completed in accordance with plans stamped by a registered professional engineer, architect, landscape architect or land surveyor, a written statement by such a professional shall be submitted, certifying substantial compliance with the plans, setting forth what deviation(s), if any, exists with the record plans approved in the Order. This statement shall accompany the request for a Certificate of Compliance and fee, along with an updated sequence of color photographs of the undisturbed buffer zone.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands

WPA Form 5 – Order of Conditions

Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

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E. Signatures

This Order is valid for three years, unless otherwise specified as a special condition pursuant to General Conditions #4, from the date of issuance.

MAY 16 2024
1. Date of Issuance

Please indicate the number of members who will sign this form.
This Order must be signed by a majority of the Conservation Commission.

1
2. Number of Signers

The Order must be mailed by certified mail (return receipt requested) or hand delivered to the applicant. A copy also must be mailed or hand delivered at the same time to the appropriate Department of Environmental Protection Regional Office, if not filing electronically, and the property owner, if different from applicant.

Darcy Karle Signature	Darcy Karle Printed Name
Signature	Printed Name
Signature	Printed Name
Signature	Printed Name
Signature	Printed Name
Signature	Printed Name
Signature	Printed Name
Signature	Printed Name

☐ by hand delivery on

Date

☒ by certified mail, return receipt requested, on MAY 16 2024

Date

Doc No 14660124

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands
WPA Form 5 – Order of Conditions
Massachusetts Wetlands Protection Act M.G.L. c. 131, §40

Provided by MassDEP:
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City/Town

F. Appeals

The applicant, the owner, any person aggrieved by this Order, any owner of land abutting the land subject to this Order, or any ten residents of the city or town in which such land is located, are hereby notified of their right to request the appropriate MassDEP Regional Office to issue a Superseding Order of Conditions. The request must be made by certified mail or hand delivery to the Department, with the appropriate filing fee and a completed Request for Departmental Action Fee Transmittal Form, as provided in 310 CMR 10.03(7) within ten business days from the date of issuance of this Order. A copy of the request shall at the same time be sent by certified mail or hand delivery to the Conservation Commission and to the applicant, if he/she is not the appellant.

Any appellants seeking to appeal the Department's Superseding Order associated with this appeal will be required to demonstrate prior participation in the review of this project. Previous participation in the permit proceeding means the submission of written information to the Conservation Commission prior to the close of the public hearing, requesting a Superseding Order, or providing written information to the Department prior to issuance of a Superseding Order.

The request shall state clearly and concisely the objections to the Order which is being appealed and how the Order does not contribute to the protection of the interests identified in the Massachusetts Wetlands Protection Act (M.G.L. c. 131, § 40), and is inconsistent with the wetlands regulations (310 CMR 10.00). To the extent that the Order is based on a municipal ordinance or bylaw, and not on the Massachusetts Wetlands Protection Act or regulations, the Department has no appellate jurisdiction.

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G. Recording Information

Prior to commencement of work, this Order of Conditions must be recorded in the Registry of Deeds or the Land Court for the district in which the land is located, within the chain of title of the affected property. In the case of recorded land, the Final Order shall also be noted in the Registry's Grantor Index under the name of the owner of the land subject to the Order. In the case of registered land, this Order shall also be noted on the Land Court Certificate of Title of the owner of the land subject to the Order of Conditions. The recording information on this page shall be submitted to the Conservation Commission listed below.

Barnstable
Conservation Commission

Detach on dotted line, have stamped by the Registry of Deeds and submit to the Conservation Commission.

To:

Barnstable
Conservation Commission

Please be advised that the Order of Conditions for the Project at:

425 Sandy Neck Road, West Barnstable — Project Location
SE3-6179 — MassDEP File Number

Has been recorded at the Registry of Deeds of:

County | Book | Page

for: Property Owner

and has been noted in the chain of title of the affected property in:

Book | Page

In accordance with the Order of Conditions issued on:

Date

If recorded land, the instrument number identifying this transaction is:

Instrument Number

If registered land, the document number identifying this transaction is:

Document Number

Signature of Applicant

Doc:1,502,726 05-23-2024 2:20
BARNSTABLE LAND COURT REGISTRY

MASSWILDLIFE

DIVISION OF
FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581
p: (508) 389-6300 | f: (508) 389-7890
MASS.GOV/MASSWILDLIFE

April 30, 2024

Mark Ells, Town Manager
Town of Barnstable
367 Main Street
Barnstable MA 02601

RE: Applicant: Mark Ells, Barnstable Town Manager
Project Location: Sandy Neck Beach
Project Description: Sandy Neck Beach Long-Term Coastal Resiliency Project – Relocation of Parking Facilities and Gatehouse
NHESP File No.: 23-4196

Dear Applicant:

The Natural Heritage & Endangered Species Program of the Massachusetts Division of Fisheries & Wildlife (the "Division") received the April 2024 Notice of Intent for Sandy Neck Beach Long-Term Coastal Resiliency Project submitted in compliance with the rare wildlife species section of the Massachusetts Wetlands Protection Act Regulations (310 CMR 10.37).

Based on a review of the information provided and the information currently contained in our database, the proposed project will occur **within** mapped *Priority Habitat* and *Estimated Habitat* of the following species:

Scientific Name	Common Name	Taxonomic Group	State Status
Charadrius melodus	Piping Plover	Bird	Threatened*
Sternula antillarum	Least Tern	Bird	Special Concern
Sabatia kennedyana	Plymouth Gentian	Plant	Special Concern
Malaclemys terrapin	Northern Diamond-backed Terrapin	Reptile	Threatened
Scaphiopus holbrookii	Eastern Spadefoot	Amphibian	Threatened

State-listed species and their habitats are protected in accordance with the MESA. *The Piping Plover is federally protected as "Threatened" pursuant to the U.S. Endangered Species Act (ESA, 50 CFR 17.11).

WETLANDS PROTECTION ACT (WPA)

The purpose of the Division's review under the WPA regulations is to determine whether the project will have any adverse effects on the Resource Area Habitats of state-listed species. Based on the information provided and the information contained in our database the Division has determined that the Sandy Neck Beach Long-Term Coastal Resiliency Project, as currently proposed **must be conditioned in order to avoid adverse effects** to the Resource Area Habitats of Piping Plover (310 CMR 10.37). **To avoid adverse effects to the Resource Area Habitats of Piping Plover, the following conditions must be met.**

1. **Time of Year Restriction.** Work located upon the coastal beach and seaward face of the dune (including dune restoration) shall not occur during the shorebird breeding period **April 1 – August 31**, unless otherwise approved in writing by the Division.

Provided this condition is fully implemented and included in any final approving Orders of Conditions, the project will not result in an adverse impact to the Resource Area Habitats of Piping Plover. We ask that the Conservation Commission send a copy of the final Order of Conditions, approving or denying the project, to the Division simultaneous with the applicant. Please note that this determination addresses only the matter of ***rare*** *wildlife habitat and does not pertain to other wildlife habitat issues that may be pertinent to the proposed project.*

MASSACHUSETTS ENDANGERED SPECIES ACT (MESA)

On July 21, 2023, the Division issued a determined pursuant to the MESA (321 CMR 10.18(2)(b)) that the Sandy Neck Beach Long-Term Coastal Resiliency Project will result in a prohibited **Take** of Eastern Spadefoot (*Scaphiopus holbrookii*). Projects resulting in a Take of state-listed species may only be permitted if they meet the performance standards for a Conservation and Management Permit (CMP; 321 CMR 10.23). The Applicant is required to obtain a CMP from the Division prior to initiating any work on the proposed project.

No soil or vegetation disturbance, work, clearing, grading or other activities related to the subject filing shall be conducted anywhere on the project site until the MESA permitting process is complete. Please note that this determination addresses only the matter of state-listed species and their habitats. If you have any questions regarding this letter please contact Amy Hoenig, Senior Endangered Species Review Assistant, at Amy.Hoenig@mass.gov.

Sincerely,

Jesse Leddick
Assistant Director

Cc: Nina Coleman, Town of Barnstable Marine & Environmental Affairs Department
Amber Unruh, Town of Barnstable
Leslie Fields, Woods Hole Group, Inc.
Steve Riberdy, Goddard Consulting LLC

Town of Barnstable
Conservation Commission
230 South Street
Hyannis Massachusetts 02601

Office: 508-862-4093 conservation@town.barnstable.ma.us

Form A B

For SE3-_____

ALL PARTIES INVOLVED WITH THIS PROJECT MUST SIGN THIS STATEMENT

The undersigned confirm that they have read and understand the Notice of Intent, Order of Conditions, and approved plans for the project. The undersigned also understand that subsequent plan revisions shall require advance approval by the Conservation Commission. **Please SIGN and PRINT name.**

Property Owner	Phone number	
Signature	E-mail address	Date

Applicant (if different from owner)	Phone number	
Signature	E-mail address	Date

Project Supervisor	Business Name	Cell phone no.	Bus. Phone no.
Signature	E-mail address	Date	

Alternate Project Supervisor	Business Name	Cell phone no.	Bus. Phone no.
Signature	E-mail address	Date	

Please return this form to: Barnstable Conservation Division
230 South Street
Hyannis, MA 02601

or e-mail as a .pdf attachment to:
conservation@town.barnstable.ma.us

Eastern Spadefoot Protection Plan (ESPP)

for

425 Sandy Neck Road
Barnstable, MA

MA NHESP File No. 07-21418

DATE:
November 22, 2024
Revised: March 5, 2025

PREPARED BY:
Goddard Consulting LLC
291 Main Street, Suite 8
Northborough, MA 01532

PREPARED FOR:
Woods Hole Group
107 Waterhouse Road
Bourne, MA 02532

1.0 INTRODUCTION

This Eastern Spadefoot Protection Plan (ESPP) has been developed in compliance with Conditions of the pending MESA Checklist Review for parking improvements at 425 Sandy Neck Road, Barnstable MA (see Locus Map below). The project site has been determined to provide habitat for the Eastern Spadefoot Toad (*Scaphiopus holbrookii*).

In summary, prior to any work, a barrier fence shall be installed around the perimeter of the limit of work (LOW), so that an impenetrable barrier encircles the entire work area during the active season. Additional barriers will be added in areas where there is no LOW indicated on the plan so that the entire project area is sealed off from the surrounding natural habitat.

Temporary access gate(s) shall be installed along the construction entrance to the work area. The gate shall be closed at the end of work every day throughout the active season. The barrier fence can be installed at any time of year, but no work on the project can begin until Eastern Spadefoot (ES) sweeps (described below) have been conducted. Sweeps must be performed within 30 days of barrier fence installation, or at the first following qualifying event, during the active season and prior to any work taking place on the project. Regular inspection of the barrier shall take place by a qualified individual during the active season.

This ESPP also provides for initial ES awareness training procedures for contractors/property owners, installation of ES barriers (silt fence), inspection and approval of this barrier, sweeping (searching) the site for ES after the fence is installed, relocating them if found, and maintenance of the ES barrier during construction.

The Primary ESPP Components include:

1. Contractor education
2. Time of year restrictions for work
3. Eastern Spadefoot barrier fencing
4. Review and approval of the ES barrier
5. Pre-construction sweeps in advance of clearing/work for ES
6. Signage
7. Site inspections by Biologist and NHESP Reporting

1.1 DEFINITIONS

Work: Site grading, clearing, grubbing, excavation, parking lot installation.

Biologist: Shall be a person hired by the contractor, who is experienced in the biology of the Eastern Spadefoot and has experience in implementing similar ESPP's in the past. The Biologist must be approved by MA NHESP prior to work and obtain a valid scientific collector's permit prior to conducting site sweeps.

Active / Inactive Season: The Active Season is defined as April 1 to October 31 and the Inactive Season is defined as November 1 to March 31.

2.0 EASTERN SPADEFOOT PROTECTION PLAN

2.1 CONTRACTOR EDUCATION AND AWARENESS

One of the primary components of the ESPP is education and awareness training to the contractor/owner and their crews as these persons are on site daily and have the highest chance of encountering ES. The biologist will present a short, detailed training session to the contractor and primary field crews prior to start of work in ES habitat. This training session will include basic identification and biology of the rare amphibian(s). This training will detail procedures to follow if an ES is encountered on site, the role of the barriers, the details of this ESPP and stress the importance of maintaining the limits of work and not having impacts to areas beyond what is permitted. ES information sheets that detail a summary of this training will be provided and posted on site.

2.2 TIME OF YEAR RESTRICTIONS

Work on site **CANNOT** occur between November 1 and March 31 (inactive season), unless the work area is encircled with barrier (as shown on the following page) prior to October 31, and the area is swept/cleared for ES during the active season. Therefore, if the sweeps do not take place between April 1 and October 31 of a given year, after qualifying events, no work on the project can take place until after sweeps are performed the following April. If these conditions are met, then work within the barrier can occur during the winter months. Work may occur within the barrier during the active season provided the sweeps have occurred first and the barrier is properly maintained. Work outside of the barrier must be approved by the biologist prior to work and may require daily on-site presence of the biologist.

2.3 BARRIER FENCING

Work area(s) must be encircled with silt fence or another approved barrier. No mesh backing is to be used. Silt fences should be staked in, rigid and vertical. This barrier shall be **CONTINUOUS** without gaps. The barrier shall also include informational signage placed on the outside of the fence at regular intervals to inform the public about the importance of not disturbing the area. This barrier shall be removed immediately after work is completed, upon completion of loaming and seeding of the new development area. If exclusion was successful, no ES should be found within the excluded area. If temporary access points are needed in this barrier, they can be constructed by leaving a small gap in the fencing just large enough for vehicle access and placing a wooded gate, secured in place in the gap which can be moved to allow access and replaced when done or alternatively replacing the silt fence.

Example of ES Barriers

Under no circumstances shall these access points be left open overnight or when active work is not occurring on site, as ES could re-gain access to the work area and the site would need to be re-swept. If work will take longer than one winter and extend into the following active ES season, the barrier should be maintained over the winter and the biologist re-inspect the barrier and corrections / repairs should be made prior to April 1. If this does not occur, re-sweeping of the entire work area may be needed.

Barrier fence installation instructions are as follows:

- A silt fence barrier shall be installed along the limit of work. This will act as a physical demarcation for site contractors but will also act as a barrier to any ES that may be inclined to stray into the work zone.
- Installation of the barrier must be conducted using methods that result in a minimum of disturbance (i.e., hand-dug, "2-man" trencher or auger). It is not appropriate to clear large access paths prior to sweeps for ES. No clearing may occur outside of the limit of work approved by the NHESP.
- The barrier must be composed of at least 18 inches (or greater) of vertical barrier above ground and an additional 3-6 inches buried below ground.
- The face of the material must be relatively smooth. Materials commonly used are staked at 6–10-foot intervals and include tightly woven geotextile, aluminum flashing, or other such materials stapled or tacked to stakes. Loosely woven geotextile fabrics, hay/straw bales, wattles or tubular materials are not generally sufficient.
- The bottom of the silt fencing must be carefully buried in a 3-6-inch-deep trench. The trench must be backfilled and compacted. (This may be subject to change based on factors including but not limited to soil type, type of fence installation, or use of subsurface barrier installed both horizontal barrier element).
- If hay or straw bales are to be used with silt fencing, they shall be installed on the work-side of the silt fence to avoid ES using these to climb up on to breach the barrier.
- Once installed, the barrier shall be taut between the stakes. Slumps or loose materials will undermine the effectiveness of the barrier. In some circumstances, geotextile fabrics may need to be reinforced with backer material to ensure integrity. Backer material is typically similar to hardware cloth.
- Informational signage shall be installed at regular intervals along the fence to inform the public of the importance of not disturbing the area.
- At the completion of the installation, an inspection by Goddard Consulting will be performed to ensure proper installation.
- The barrier shall be removed completely upon completion of loaming and seeding of the new development area.
- If the barrier is to be removed during the active season, removal must be done by hand (no use of ground penetrating tools) and commence no sooner than 1 hour prior to sunset on a given date.
- Removal of the barrier during the inactive season do not require any special conditions, provided that any ground-penetrating tools used to not penetrate greater than 12 inches below the ground surface.

2.4 SITE ACCESS

If continuing access to the work area is required, a construction access gate shall be installed at the entrance. The gate shall be closed at the end of each workday so that no ES can enter the work area through the only opening in the barrier. An example of a suitable gate, consisting of plywood and 2x4s, is shown in the following photos:

Example of ES Gates

Example of ES Gates

Alternative gate designs can be used instead of the above examples, provided that they are at least three feet tall and are flush with the ground so no ES can burrow underneath **AND PROVIDED THAT THE DESIGN IS APPROVED BY NHESP**. The access gate will be inspected and approved by Goddard Consulting prior to the start of work on the project.

At this time, it is expected that each sweep zone will be completely closed off and no gates will be required.

2.5 BARRIER INSPECTION AND APPROVAL

After the barrier is installed, it shall be inspected by the biologist for integrity and given verbal signoff from the biologist that the barrier is adequate. If modifications or repairs need to occur, the biologist will notify the contractor and NHESP and such repairs or modifications will occur prior to ES sweeps. Notes on any repairs or modifications will be taken for inclusion in the final report. The active season for ES in MA is from April 1 to October 31. One day prior to the commencement of construction, the barrier shall be checked for integrity.

During the Active Season - Once every week, a person familiar with barrier maintenance and installation or the approved biologist shall inspect the barrier and facilitate any repairs or alterations. The barrier should remain taught between stakes and any holes along the bottom repaired.

Outside the Active Season – During late March and only if the barrier remains in place over the winter, then the biologist shall conduct an early season inspection of the barrier and facilitate any repairs or alteration necessary for the barrier to function for ES protection. Barrier does not need to be inspected weekly during inactive season.

At the Completion of Project – Removal of temporary fencing will take place at the end of construction.

2.6 EASTERN SPADEFOOT SWEEPS

Sweeps must be performed within 30 days of barrier fence installation, during the active season and prior to any work taking place on the project. Sweeps will be conducted once per week in the 4 weeks preceding commencement of construction work on site. Construction during the active season to begin no sooner than June 15. If work is to commence during the inactive season, sweeps should be done once per week during the 4-week period of September 7 - October 5. The area will be swept for ES on four separate dates prior to any clearing or earthwork. Sweeps must be performed during the active season (April 1 to October 31). Therefore, if the sweeps do not take place between April 1 and October 31 of a given year, no work on the project can take place until after sweeps are performed the following April.

Sweeps must occur after installation of the barrier but before any heavy machinery enters the work zone or any soil or vegetation alteration commences. Following barrier installation:

- The biologist shall inspect the barrier and facilitate any repairs/alterations necessary to ensure the integrity of the barrier.
- Sweeps by the biologist must occur within start at least 30 minutes after sunset and should be 4 hours long during a "qualifying event". Select survey nights based on the forecasted and/or observed weather conditions. Qualifying events are broken into five categories with varying importance.
- Highest (1) to lowest (5) importance is as follows:

1. Probable Breeding Emergence = Greater than 2" of rain in the preceding 24-hour period, air temperatures holding above 50°F until at least midnight
2. Probable Feeding Emergence = Air temperature and relative humidity holding above 65°F and 80%, respectively, from dusk to dawn.
3. Potential Breeding Emergence = Greater than 1" of rain in the preceding 24-hour period, air temperature holding above 45°F until at least midnight.
4. Potential Dispersal/Burrow-shifting Emergence = Steady rain at an air temperature holding above 55°F for a period of at least several hours.
5. Potential Feeding Emergence = Air temperature and relative humidity holding above 50 and 70%, respectively, from dusk to dawn.

- Searches must include looking along the inside perimeter of the barrier fence, along any access paths traveled by heavy machinery, and within the entire area inside the barrier.
- Sweeps will consist of a headlamp/eyeshine survey looking for foraging individuals on the surface. Any ESs found will be hand captured for immediate release to appropriate areas on site.
- Each Eastern Spadefoot encountered during sweeps shall be handled with a fresh pair of clean nitrile gloves and moved to the opposite side of the barrier fence in the direction of where the largest expanse of suitable habitat occurs (if encountered during a non-breeding event) or in the direction of travel of the nearest observed or potential breeding pool (if encountered during a breeding event).
- Any state-listed vertebrate species encountered during these searches shall be released by the biologist in appropriate habitat on site, but outside of, the construction areas.
- Any encountered American toads or Fowler's toad shall be moved in a similar fashion, to make subsequent sweep activity more efficient.
- Sweeps will be repeated 1 night per week in the 4 weeks preceding commencement of construction work.

Regular inspection of the barrier shall take place by qualified individuals during the active season. The level of effort will consist of **4 person-hours per acre spread out among the four sweep dates**. The area of toad exclusion zones is 4.17 acres, over 7 discrete areas (Table 1 and Toad Fencing Plan) according to the approved plans, therefore 16.7 sweep hours should be spent in total (4.2 hours per sweep).

Table 1: Toad Sweep Areas

Sweep Area	Size (SF)
A	7,219
B	4,470
C	150,355
D	2,473
E	778
F	7,280
G	9,044
TOTAL	**181,619 SF (4.17 acres)**

Sweeps of work areas will be conducted by a *highly qualified individual* who has direct and extensive experience working with state-listed rare amphibians and reptiles and with direct experience conducting nocturnal visual surveys for Eastern Spadefoot. Steven Riberdy of Goddard Consulting will conduct all sweeps under a Commercial Scientific Collection Permit. Any other individuals performing sweeps while not under the direct supervision of Steven shall be

pre-approved by NHESP. Acceptance of this ES protection plan by NHESP will be presumed to include approval of Steven Riberdy as the NHESP-approved biologist.

2.7 SITE INSPEECTIONS AND REPORTING

The NHESP shall be notified at least 48 hours prior to any activities to be performed subject to this ESPP. Upon confirmation from the Biologist that the work to be performed is in compliance with this ESPP, and acknowledgement of the report by NHESP, work may be initiated.

After final ES sweeping is complete, the lead biologist will inspect the fence to confirm its integrity once every three weeks during a qualifying event, during which the biologist will also perform a limited sweep. If no qualifying event occurs during this timeframe, at a minimum the fence inspection will occur once every three weeks. The limited sweep will be a total of 6 sweep hours spread across all project areas.

Within 30 days of the completion of searches by the biologist, *a report must be submitted to the NHESP* indicating: the dates of each pre-work search clearly stating the name of the individual(s) conducting work at each search period; the number of hours searched per date; presence or absence of ES; information on any amphibians or reptiles found, whether state-listed or not; and the condition of the barrier and any repairs. If a state-listed species is encountered at any time, it shall be documented with photographs, a rare animal observation form (via VPRS online system) will be filled out and submitted to NHESP, and the animal will be released into suitable habitat outside of the work area.

2.8 CONTRACTOR RESPONSIBILITIES

In order for this ESPP to be effective, the contractor must actively engage the Biologist in work schedules, be aware of the permitted limits of work, and relay the concerns and sensitive nature of this species on site to the daily workers. Responsibilities of the contractor include:

1. Maintain barrier in good working order, inspect daily, repair immediately if breaches are found.
2. Maintain limit of work, with no work beyond what is approved.
3. Install and Maintain signage, stating no trespass or altering of the barriers.
4. Contact the Biologist if an amphibian is found to be certain it is not a rare amphibian.
5. Once per week, a person familiar with barrier maintenance and installation shall inspect the barrier and facilitate any repairs or alterations. The limit of work barrier should remain taut between stakes and any holes along the bottom repaired.
6. If an ES is seen outside of work area note location so the biologist can obtain a GPS point later, if in work area and ES moves on before the biologist arrives, take photos if possible and also note location for GPS location by the biologist.

MA ENDANGERED SPECIES ACT (G.L. c.131A)
CONSERVATION AND MANAGEMENT PERMIT

DATE		March 2025 (DRAFT)
CONSERVATION PERMIT NO.:		CMP-92040
NHESP FILE NO.		23-4196
PERMIT HOLDER		Town of Barnstable 382 Falmouth Road Hyannis MA 02601
PROJECT		Sand Neck Beach Facilities Relocation - Coastal Resiliency Project

A. Permit Authority

Pursuant to the authority granted in the Massachusetts Endangered Species Act ("MESA") (G.L. c. 131A) and its implementing regulations (321 CMR 10.23), the Director of the Massachusetts Division of Fisheries & Wildlife (the "Division") hereby issues a Conservation and Management Permit (the "Permit") to the Town of Barnstable (the "Permit Holder"). This Permit authorizes the Take of the Eastern Spadefoot (*Scaphiopus holbrookii*), which is State-listed as Threatened, pursuant to the MESA, arising out of the construction and relocation of Sandy Neck Beach Facilities (the "Project") on the ±1,168-acre Sandy Neck Beach Conservation Area boarded by Cape Cod Bay to the north and Barnstable Great Marsh to the south located off of Sandy Neck Road in the Town of Barnstable, Massachusetts (Book ____, Page ____, _____ County Registry of Deeds; the "Property").

B. Description of Take

The Property consists of a barrier beach complex that contains a mixture of dunes with interdunal swales, isolated wetlands, with patches of coastal oak forest and pitch pine-scrub oak woodlands. The Sandy Neck Beach Facility includes existing parking areas, gate house, paved roadway, and sand beach access road. The project proposes to relocate and reconfigure existing infrastructure to improve coastal resiliency at the site. The existing parking area will be relocated landward and the gate house will be relocated to a higher elevation.

On June 21, 2023 the Division determined that the proposed Project will result in a Take of Spadefoot through the permanent and temporal loss and fragmentation of ±5.15 (±1.83 acres permanent) highly suitable habitat and interference with the feeding, breeding, overwintering, refuge, and dispersal activities of this species.

C. Permit Performance Standards

Under the authority granted by and in accordance with MGL c131A§3 and 321 CMR 10.23, the Director may permit the Take of a State-listed species for conservation and management purposes provided that there is a long-term Net Benefit to the conservation of the impacted species. If the Director determines that the applicant for a permit has avoided, minimized and mitigated impacts to the State-listed species consistent with the following performance standards, then the Director may issue a conservation and management permit, provided:

(a) the applicant has adequately assessed alternatives to both temporary and permanent impacts to State-listed species;
(b) an insignificant portion of the local population would be impacted by the Project or Activity, and;
(c) the applicant agrees to carry out a conservation and management plan that provides a long-term Net Benefit to the conservation of the State-listed species that has been approved by the Director, as provided in 321 CMR 10.23(5), and shall be carried out by the applicant.

The Director has determined that the applicant for this Permit has met the above noted performance standards and that the conservation and management plan described herein provides a long-term Net Benefit to the conservation of the Spadefoot.

D. Conservation and Management Plan

In order to provide a long-term Net Benefit to the conservation of Spadefoot, the Permit Holder has proposed, by way of the Permit Application, to provide $123,177.60 funding for land protection, conservation research, habitat management and or conservation planning to benefit the Spadefoot in Massachusetts. In order to avoid and minimize impacts to the Spadefoot, the Permit Holder has proposed, by way of the Permit Application, to: (a) install and maintain temporary barriers throughout construction; (b) have a qualified biologist conduct visual sweeps in work areas; (c) educate construction staff about the likely presence of State-listed species on the Property and appropriate responses to any sightings; and (d) restore 0.88 acres of parking, 3.33 acres of temporary impact, and enhance 0.06 ac of habitat for Spadefoot.

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Therefore, the Project can be permitted pursuant to the MESA. This Permit is issued to condition the Project and to provide a long-term Net Benefit to the Spadefoot.

E. Documents and Plans of Records

In accordance with the documents and plans of record submitted to the Division entitled:

- "Conservation and Management Permit Application" (dated 03/05/2025; prepared Goddard Consulting, Inc.; the "Permit Application");
- Sandy Neck Beach Facility Reconfiguration (revised 10/19/07; prepared by Coastal Engineering, Inc.; the "Plans of Record"; Attachment 1);
- "Eastern Spadefoot Protection Plan (ESPP)" (Revised 4/*/2025; prepared by Goddard Consulting, Inc.; the "Protection Plan"; Attachment 2);
- Draft "Escrow Agreement" (Attachment 3);

and any other plans and documents referenced herein (collectively, the "Plans of Record"), this Permit is issued with the following General and Special Conditions:

Commented [AH1]: I need to attach a the plan of record here. Is there a site plan presented on a single sheet that shows the entire project with limit of work? The Tighe and Bond site plans are 40+ sheets.
Looking for something similar to Fig 5, but as a site plan.

Commented [AH2]: 1.Please update per conversation with biologist: exclusion barrier can be installed as follows, silt fence barrier staked with 12 inch ground parallel component covered with approx. 3-4inches of sand (shoveled). Vertical components installation remains the same.
2.Please then remove draft from the document and update date.

Commented [AH3]: Update draft for this project. I think we can issue a CMP with the stock Escrow template, if needed.

F. General Conditions

GC 1.		The Permit Holder shall comply with all General and Special Conditions of this Permit and complete the Project consistent with all Division-approved plans and supporting documents referenced herein, except as otherwise approved by the Division in writing.
GC 2.		A violation of any General or Special Condition of this Permit may result in an unauthorized Take and may be subject to civil and or criminal penalties pursuant to M.G.L. c. 131A. The Division reserves the right to require an immediate cessation of Work (as defined in Special Condition #1), in whole or in part and at its sole discretion, should the Permit Holder violate any General or Special Condition of this Permit.
GC 3.		The Permit Holder shall submit in writing any documents, plans, reports, or other items required for submission in accordance with this Permit, for review and written approval by the Division, except as otherwise approved by the Division in writing.
GC 4.		Division representatives shall have the right to enter and inspect the Property subject to this Permit at reasonable hours to evaluate Permit compliance, and to require the submittal of additional, reasonable information not otherwise required by this Permit if deemed necessary by the Division to complete its evaluation.
GC 5.		Any land protected to achieve a long-term Net Benefit associated with this Permit shall remain undeveloped and protected as habitat for State-listed species in perpetuity.
GC 6.		This Permit shall not preclude the review of future projects on the Property that are subject to the Wetlands Protection Act Regulations (310 CMR 10.37, 10.58(4)(b), 10.59), as applicable, by the Division.
GC 7.		This Permit does not relieve the Permit Holder of the necessity of complying with all applicable federal, state or local statues, ordinances, bylaws or regulations, including but not limited to those administered by the Town of Barnstable Conservation Commission and the Massachusetts Department of Environmental Protection.
GC 8.		All Work shall be in conformance with the Plans of Record. Any changes, updates, or revisions to the Project, or any additional work beyond that shown on the Plans of Record, shall require additional review and approval by the Division prior to implementation, pursuant to General Condition #9. This Permit prohibits any work not specifically authorized by this Permit, unless otherwise approved by the Division in writing prior to performing the additional work.
GC 9.		Any proposed change to any plan identified in this Permit, or to the State-listed species conservation and management plan required by way of this Permit, shall require the Permit Holder to inquire of the Division, in writing, whether the change is significant enough to require the filing of a new Conservation and Management Permit Application, and or require additional long-term Net Benefit for the affected State-listed species. The Division retains the right to require the submittal of additional, reasonable information to evaluate the proposed plan change.
GC 10.		This Permit shall apply to, and inure to the benefit of, the Permit Holder and any successor-in-interest of the Permit Holder, or to a subsequent successor-in-control of the Property or portion thereof subject to this Permit should the Permit Holder convey its record ownership of the Property to said successor-in-control, as well as to any contractor or other person performing Work conditioned by this Permit. Within three (3) days of the transfer of an interest in the Property or a portion thereof, any successor-in-interest or subsequent successor-in-control [i.e., subsequent owners or operators] of the Property or a portion thereof shall provide the Division with a letter indicating (1) that the successor is the successor-in-interest of the Permit Holder or the successor-

		in-control [i.e., current owner or operator] of the Property or a portion thereof, and (2) that said successor will perform the obligations of the Permit Holder as set forth in this Permit.
GC 11.		**Prior to the initiation of Work**, the Permit Holder shall notify the Division in writing of the name, address, email, business and or cell phone numbers of the project supervisor(s) and/or contractor(s) responsible for compliance with this Permit. The Permit Holder shall provide updated information in writing to the Division should new or additional project supervisors and/or contractors be hired after Work has commenced. **Prior to the initiation of Work**, said project supervisor(s) and/or contractor(s) shall be provided a copy of the Permit and acknowledge in writing their receipt and understanding of the Permit. Said project supervisor(s) and/or contractor(s) may be held responsible for violations of this Permit performed by said project supervisor(s) and/or contractor(s).
GC 12.		**Prior to the initiation of Work**, the text of this Permit shall be recorded by the Permit Holder in the Registry of Deeds or the Land Court for the district in which the Property is located so as to become a record part of the chain of title of the Property. In the case of recorded land, the Permit shall be noted in the Registry's Grantor Index under the name of the owner of the Property upon which the proposed Work is to be done. In the case of registered land, the Permit shall be noted on the Land Court Certificate of Title of the owner of the Property upon which the proposed Work is done. The Permit Holder shall submit to the Division a date-stamped and signed copy of said recorded Permit showing the date and book and page of recording within five (5) business days after recording and/or filing, as applicable. No Work shall be initiated on the Property until the Permit is recorded and said recorded copy is submitted to the Division, except as otherwise approved by the Division in writing.
GC 13.		**Prior to the initiation of Work**, the Permit Holder shall send a summary report to the Division which: (a) demonstrates compliance with all pre-Work General and Special Conditions of the Permit; and (b) requests permission to initiate the Work authorized by the Permit. Unless otherwise authorized by the Division in writing, **no Work may be initiated on the Property** until the Permit Holder has received written confirmation from the Division confirming compliance with all pre-Work General and Special Conditions and authorizing the initiation of Work. **Within three (3) days of the initiation of Work**, the Permit Holder shall send a letter to the Division confirming the date upon which Work commenced.
GC 14.		**Within (3) months of the completion of Work** the Permit Holder shall submit to the Division a written request for a Certificate of Permit Compliance (the "Certificate"), including as-built plans and other supporting materials demonstrating the completion of Work and compliance with all General and Special Conditions of the Permit. The text of the Division-issued Certificate shall be recorded by the Permit Holder in the Registry of Deeds or the Land Court for the district in which the Property is located so as to become a record part of the chain of title of the Property. Unless an extension is granted in writing by the Division pursuant to General Condition #15, the Permit Holder shall record the Division-issued Certificate **prior to expiration of the Permit**. The Permit Holder shall submit to the Division a date-stamped and signed copy of said recorded Certificate showing the date and book and page of recording **within five (5) business days after recording and or filing**, as applicable.
GC 15.		The Project authorized by this Permit shall be completed within five (5) years from the date of issuance. If needed, the Permit Holder shall submit a written request to the Division for an extension of time to complete said Project, and the Division will review the Project pursuant to MESA for any continuing impacts as described herein and for any new impacts to any State-listed species found subsequent to the issuance date of this Permit. Said request shall be submitted to

		the Division at least sixty (60) days prior to expiration of this Permit, and shall include a summary report demonstrating compliance with all General and Special Conditions of this Permit.

G. Special Conditions

SC 1.		Work Authorized by the Permit: This Permit authorizes the construction and relocation of the Sandy Neck Beach parking area and gate house pursuant to the Plans of Record and as shown on the Project Plan (the "Work"; Attachment 1). The Work also includes any other on-site activity required by the Division as a condition of this Permit. All Work shall be confined to the area of the Property within the limits of Work shown on the Project Plan (Attachment 1).
SC 2.		Temporary Demarcation of Limits of Work: **Prior to the initiation of Work** and in accordance with the Spadefoot Protection Plan, the limits of Work shown on the Project Plan (Attachment 1) shall be monumented and marked with temporary flagging, silt fencing, and or other similar visual marker sufficient to clearly delineate the limits of Work shown on the Plans of Record.
SC 3.		Spadefoot Protection Plan: **Prior to the initiation of Work**, the Permit Holder shall implement protective measures for state-listed species in accordance with the Spadefoot Protection Plan (Attachment 2), which has been approved by the Division. All Work shall occur pursuant to the protective measures outlined within said Plan, which shall be implemented as written unless otherwise approved by the Division in writing. Any proposed changes to said Plan shall be submitted to the Division for review and written approval prior to implementation of any changes. Said Plan must be implemented by a qualified, Division-approved wildlife biologist in possession of a valid Scientific Collection Permit obtained from the Division. The wildlife biologist shall prepare and deliver an annual report documenting implementation of and compliance with said Plan by December 31 of each year in which Work associated with the Project occurs.
SC 4.		State-listed Species Conservation/Research: In order to provide a Net Benefit to the conservation of the State-listed species impacted by this Project, the Permit Holder has proposed to provide restricted funding in the amount of $123,177.50 (total includes the 12% administration fee) (the "Funds") for land protection, conservation research, habitat management and or conservation planning to benefit the Spadefoot in Massachusetts. The Permit Holder has chosen to fulfill this obligation by providing restricted funding to an escrow account, subject to an escrow agreement in substantially the same form shown in Attachment 3, which has been approved by the Division. Any changes to said agreement, other than typographical or grammatical changes, must be approved in writing by the Division before the escrow is established. Therefore, **prior to the initiation of Work** the Permit Holder shall send written confirmation to the Division of depositing the Funds into an escrow account subject to the escrow agreement (Attachment 3), including written confirmation of deposit receipt and an electronic copy of the executed escrow agreement. The Division, and not the Permit Holder, shall have sole responsibility for insuring that the Funds are used for land protection, conservation research, habitat management and/or conservation planning to benefit the State-listed species impacted by this Project.
SC 5.		Piping Plover Protection Measures: The Permit Holder shall implement a Time of Year (TOY) Restriction from **April 1 – August 31** for all work associated with dune nourishment and dune restoration located on the seaward dune or coastal beach. Any proposed work associated with the project located on the coastal beach or seaward dune during the TOY Restriction shall be submitted to the Division for review and written approval. Additionally, any request for this TOY incursion requires a monitoring and protection plan for state-listed coastal nesting birds. Said monitoring and protection plan shall be submitted to the Division for review and written approval

		prior to implementation. Said Plan must be implemented by a qualified, Division-approved biologist.
SC 6.		Construction Staff Education: All construction, landscaping, and other sub-contractors associated with the Project shall be informed in writing of the likely presence of State-listed species on the Property and what measures should be implemented to minimize direct harm to State-listed species. Further, no wildlife shall be removed from the Property without approval of a qualified, Division-approved wildlife biologist or the Division except as necessary to receive veterinary treatment in the case of harm during construction.
SC 7.		Observations of State-listed Species: The Division shall be notified, in the form of an NHESP Rare Animal or Plant Observation Form, within ten (10) days of the observation of any State-listed species within or outside the limits of Work. Visit https://www.mass.gov/how-to/report-rare-species-vernal-pool-observations for access to observation reporting forms.

H. Notice of Appeal of Rights

Town of Barnstable
Board of Health

200 Main Street, Hyannis MA 02601

Office: 508-862-4644
FAX: 508-790-6304

March 19, 2025

Mr. Timothy Grace
Tighe and Bond
85 Southampton Road
Westfield , MA 010 85

RE: 425 Sandy Neck Road, West Barnstable A= 263-001

Dear Mr. Grace,

You are granted variances, on behalf of your client, the Town of Barnstable, to construct an onsite sewage disposal system at 425 Sandy Neck Road, West Barnstable, Massachusetts.

The variances granted are as follows:

Section 360-47 of the Town of Barnstable Code: To keep an existing septic tank and an existing pump chamber which will be discontinued in use, in lieu of the requirement to excavate and remove the abandoned septic system components from the site or to completely fill abandoned components with sand.

Section 360-18(A) of the Town of Barnstable Code: To reuse an existing soil absorption system and distribution box which are both located within 100 feet of a wetland.

310 CMR 15.405 (1)(a) (Setback to Property Line): Septic system components will cross property lines of Town-owned parcels.

310 CMR 15.220(3): To provide an engineering plan which does not bear the stamp and signature of a Massachusetts Licensed Land Surveyor.

These variances were granted with the following condition:

- The existing septic tank and pump chamber components, which will both be discontinued for use, shall be inspected by a certified septic system inspector, registered sanitarian, or by a professional engineer three years from this date (sometime during the year 2028) to determine the degree of deterioration of these components, if any, and to determine whether or not these components would be viable for future re-use.

These variances will allow the applicant to re-use an existing septic tank and pump chamber for future planned renovations to a maintenance garage. These variances will also allow for a new gatehouse to be connected into a newly installed dual compartment septic tank which will be connected into an existing distribution box and soil absorption system located within 100 feet of wetlands.

Sincerely yours,

F.P. (Thomas) Lee, P.E.
Chairman
TOWN OF BARNSTABLE
BOARD OF HEALTH

SECTION 02075

GEOSYNTHETICS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes

1. Non-woven geotextiles
2. Woven geotextiles
3. Temporary degradable erosion control blanket

1.2 REFERENCES

A. Data Sheet DS1 - Non-Woven Geotextiles

B. Data Sheet DS2 - Woven Geotextiles

C. ASTM D1248 - Specification for Polyethylene Plastics Molding and Extrusion Materials

D. ASTM D1388 - Test Methods for Stiffness of Fabrics

E. ASTM D3786 - Test Method for Hydraulic Bursting Strength of Knitted Goods and Non-woven Fabrics: Diaphragm Bursting Strength Tester Method

F. ASTM D4218 - Test Method for Carbon Black Content in Polyethylene Compounds by the Muffle-Furnace Technique

G. ASTM D4491 - Test Methods for Water Permeability of Geotextiles by Permittivity

H. ASTM D4533 - Test Method for Trapezoid Tearing Strength of Geotextiles

I. ASTM D4632 - Test Method for Grab Breaking Load and Elongation of Geotextiles

J. ASTM D4751 - Test Method for Determining the Apparent Opening Size of a Geotextile

K. ASTM D4833 - Test Method for Index Puncture Resistance of Geotextiles Geomembranes and Related Products

L. ASTM D5261 - Test Method for Measuring Mass per Unit Area of Geotextiles

M. ASTM D5262 – Standard Test Method for Evaluating the Unconfined Tension Creep Behavior of Geosynthetics

N. GRI-GG1 - Geogrid Rib Tensile Strength

O. GRI-GC8 – Determination of the Allowable Flow Rate of a Drainage Geocomposite

1.3 SUBMITTALS

A. Product samples and data for all geosynthetics proposed for use on this project.

B. Manufacturer-approved construction quality assurance/quality control manual for all of the geosynthetics proposed for use on this project.

1.4 QUALITY ASSURANCE

A. Obtain from the geosynthetic product manufacturers a warranty that their products are free from defects in materials and workmanship at the time of delivery to the project site.

B. Material found to be defective or which does not conform to these specifications will be rejected.

1.5 DELIVERY, STORAGE AND PROTECTION

A. The Engineer reserves the right to reject and require replacement of any damaged materials delivered to the site, at no additional cost to the Owner.

B. Stockpile and store the materials in accordance with the manufacturer's recommendations.

C. Label and bag all geosynthetic rolls in packing that is resistant to photo degradation by ultraviolet (UV) radiation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Group 1 Non-Woven Geotextile

1. "C-46NW" as manufactured by Contech Construction Products, Inc.
2. "FX-40HS" as manufactured by Carthage Mills
3. "140NC" as manufactured by Mirafi Inc.
4. Or equal

B. Group 2 Non-Woven Geotextile

1. "4506" as manufactured by Amoco Fabrics and Fibers
2. "FX-60HS" as manufactured by Carthage Mills
3. "160N" as manufactured by Mirafi Inc.
4. Or equal

C. Group 3 Non-woven Geotextile

1. "4508" as manufactured by Amoco Fabrics and Fibers
2. "FX-80HS" as manufactured by Carthage Mills
3. "180N" as manufactured by Mirafi Inc.
4. Or equal

D. Group 4 Non-woven Geotextile

1. "4512" as manufactured by Amoco Fabrics and Fibers
2. "350 EX" as manufactured by LINQ Industrial Fabrics
3. "C-160 NW" as manufactured by Contech Construction Products, Inc.

4. Or equal

E. Group 1 Woven Geotextile

1. "2000" as manufactured by Amoco Fabrics and Fibers
2. "FX-44" as manufactured by Carthage Mills
3. "100X" as manufactured by Mirafi Inc.
4. Or equal

F. Group 2 Woven Geotextile

1. "2002" as manufactured by Amoco Fabrics and Fibers
2. "FX-55" as manufactured by Carthage Mills
3. "500X" as manufactured by Mirafi Inc.
4. Or equal

G. Group 3 Woven Geotextile

1. "2006" as manufactured by Amoco Fabrics and Fibers
2. "FX-66" as manufactured by Carthage Mills
3. "600X" as manufactured by Mirafi Inc.
4. Or equal

H. Group 4 Woven Geotextile

1. "2019" or “1199” as manufactured by Amoco Fabrics and Fibers
2. "GTF 400E" as manufactured by Linq Industrial Fabrics
3. Or equal

I. Temporary Degradable Erosion Control Blanket

1. ECS-2B as manufactured by East Coast Erosion Control
2. LANDLOK ECB-ENS2 as manufactured by Propex
3. S150BN as manufactured by North American Green
4. Or Equal

2.2 MATERIALS

A. Non-woven geotextiles shall be manufactured from a continuous polypropylene filament. A needle punching process shall achieve bonding.

B. Woven geotextiles shall be manufactured from a polypropylene slit-film monofilament.

C. Non-woven protection geotextiles shall have a minimum mass per unit area of 32oz/yd^2.

D. Temporary, degradable erosion control blankets (ECBs) shall be composed of a core of 100% agriculture straw and two external confining meshes of organic jute degradable material. The minimum manufacturer’s suggested design life of the ECB shall be 12 months.

PART 3 EXECUTION

3.1 EXAMINATION

A. Inspect all products prior to the installation for any defects that may have been the result of storage and handling. The Engineer reserves the right to reject and require replacement of any damaged product, at no additional cost to the Owner.

3.2 INSTALLATION

A. Install geosynthetic products in accordance with the approved manufacturer's QA/QC manuals, project details, and pertinent sections of these Specifications.

B. Require the geogrid manufacturer's representative to be present at the beginning of all construction of reinforced slopes to assure proper installation of geogrids.

C. All terminal ends of temporary degradable erosion control blankets shall be tied-in a minimum of 6-inches.

3.3 QUALITY CONTROL

A. The Engineer may remove a sample (i.e. a strip that is 3 feet long by the entire roll width) from a maximum of 1 roll of each 10 rolls of all geosynthetic materials delivered to the project, and submit the samples to an independent laboratory for analysis of the product to ensure that the geosynthetics meet the specifications herein.

END OF SECTION

(DATA SHEETS FOLLOW)

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Data Sheet DS1 - Non-Woven Geotextile Mechanical Properties								
Property	**Test Method**	**Units**	**Testing Frequency**	**Value**				
				Group 1	**Group 2**	**Group 3**	**Group 4**	**Group 5**
Mass per Unit Area	**ASTM D5261**	**oz/yd^2**	**1/150,000 ft^2**	**4**	**6**	**8**	**12**	**16**
AOS	**ASTM D4751**	**US Sieve**	**1/150,000 ft^2**	**70**	**70**	**100**	**100**	**100**
Permitivity	**ASTM D4491**	**gal/min/ft^2**	**1/150,000 ft^2**	**140**	**90**	**80**	**70**	**50**
Puncture Strength	**ASTM D4833**	**lbs**	**1/150,000 ft^2**	**60**	**90**	**130**	**195**	**245**
Mullen Burst Strength	**ASTM D3786**	**lbs/in^2**	**1/150,000 ft^2**	**225**	**350**	**400**	**650**	**800**
Trapezoidal Tear Strength	**ASTM D4533**	**lbs**	**1/150,000 ft^2**	**35**	**65**	**80**	**115**	**145**
Grab Tensile/Elongation	**ASTM D4632**	**lbs(%)**	**1/150,000 ft^2**	**95 (50)**	**150 (50)**	**200 (50)**	**300 (50)**	**400 (50)**

Data Sheet DS2 - Woven Geotextile Mechanical Properties							
Property	**Test Method**	**Units**	**Testing Frequency**	**Value**			
				Group 1	**Group 2**	**Group 3**	**Group 4**
Puncture Strength	**ASTM D4833**	**lbs**	**1/150,000 ft^2**	**60**	**90**	**120**	**135**
Mullen Burst Strength	**ASTM D3786**	**lbs/in^2**	**1/150,000 ft^2**	**300**	**400**	**600**	**480**
Trapezoidal Tear Strength	**ASTM D4533**	**lbs**	**1/150,000 ft^2**	**45**	**75**	**115**	**95/55**
Grab Tensile/Elongation	**ASTM D4632**	**lbs(%)**	**1/150,000 ft^2**	**120 (15)**	**200 (15)**	**300 (15)**	**350/250 (15)**

SECTION 02200

SITE PREPARATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes

1. Clearing and grubbing

2. Grading

3. Stripping and stockpiling of soil and sod

1.2 SUBMITTALS

A. Submit construction methods and equipment that will be utilized for the clearing, grubbing, and waste material disposal specified within this Section.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

A. Except as otherwise directed, cut, grub, remove and dispose of all trees, stumps, brush, shrubs, roots and any other objectionable material within the limits of the Work on the site and where required to construct the work.

B. Protect trees, groups of trees, and grasses designated by the Engineer to remain, from damage by all construction operations by erecting suitable barriers, or by other approved means. Conduct clearing operations to prevent falling trees from damaging trees designated to remain.

1. All damage done to the trees by the Contractor's operation shall be trimmed and painted where cut as directed or as necessary to provide adequate vertical clearance for construction activities. The dressing or paint shall be applied no later than two days after the cuts are made.

2. Use all necessary precautions to prevent injury to other desirable growth in all areas. Contractor shall assume full responsibility for any damage.

C. Protect areas outside the limits of clearing from damage. No equipment or materials shall be stored in these areas.

D. No stumps, trees, limbs, or brush shall be buried in fills or embankments.

3.2 DISPOSAL OF MATERIALS

A. Remove all tree trunks, limbs, roots, stumps, brush, foliage, other vegetation and objectionable material from the site and dispose of in a legal manner.

B. Burning or direct burial of cleared and grubbed materials on-site will not be permitted.

3.3 GRADING

A. In preparation for placing loam, paved drives and appurtenances, perform grading to the lines, grades and elevations shown on the Drawings, and otherwise directed by the

Engineer and perform in such a manner that the requirements for formation of embankments can be followed. All material encountered, regardless of its nature, within the limits indicated, shall be removed and disposed of as directed. During the process of grading, maintain the subgrade in such condition that it will be well drained at all times. Install temporary drains and drainage ditches to intercept or divert surface water that may affect the work when necessary.

B. If at the time of grading it is not possible to place material in its final location, stockpile material in approved areas for later use. No extra payment will be made for the stockpiling or double handling of excavated material.

C. The right is reserved to make minor adjustments or revisions in lines or grades if found necessary as the work progresses.

D. Stones or rock fragments larger than 4 inches in their greatest dimensions will not be permitted in the top 12 inches of the finished subgrade of all fills or embankments except along the access roadways and rip-rap where shown on the Drawings.

E. In cuts, loose or protruding rocks on the excavated slopes shall be barred loose or otherwise removed to line or finished grade of slope. Cut and fill slopes shall be uniformly dressed to the slope, cross-section and alignment shown on the Drawings or as directed by the Engineer.

END OF SECTION

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SECTION 02210

SUBSURFACE INVESTIGATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Soils subsurface investigation at the site, the use of data resulting from the investigation, and conditions warranting additional soils investigation.

2. Pipe and utility subsurface investigations that are required to properly locate, plan for and/or connect to the various existing utilities.

B. Related Sections

1. Section 02315 - Excavation, Backfill, Compaction, and Dewatering

2. Section 02920 – Site Restoration

1.2 REFERENCES

A. 29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.560 through 1926.562 including Appendices A through F

B. MGL Chapter 82 Section 40

1.3 QUALITY ASSURANCE

A. The entire test pit excavation and collection of utility information must be observed by the Engineer.

1.4 SITE CONDITIONS

A. Soils Investigation

1. Use of the Data

a. The Drawings indicate conditions as they are believed to exist based upon limited subsurface explorations. Investigations and field tests must be conducted to verify the conditions that exist which may affect the Work. All investigations must be conducted under the Engineer's observation.

B. Pipeline and Utility Investigations

1. The Drawings show available data relative to existing underground pipe and utilities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PREPARATION

A. Obtain all available information on buried structures and utilities in the vicinity of the investigation.

B. Coordinate Work such that all affected property, structure, and utility owners are aware of the Work prior to its commencement.

C. Schedule subsurface investigations such that they do not interfere with other Work or traffic and in advance of other Work in that location.

D. Provide the Engineer with 24-hour notice prior to commencement of subsurface investigations.

3.2 SUBSURFACE INVESTIGATIONS

A. Prior to test pitting operations, delineate the general scope of the excavation or boring on the paved surface of the ground using white paint, or stakes or other suitable white markings on non-paved surfaces and coordinate with the appropriate agencies in accordance MGL Chapter 82 Section 40. Pre-marking will not be acceptable if such marks can interfere with traffic or pedestrian control or are misleading to the general public. Pre-marking will not be required of any continuous excavation that is over 500 feet in length

B. Excavate test pits as indicated, or as requested by the Owner. Expose the top of the pipeline, and adjacent utilities, at each test pit location.

C. Contractor may, at its expense and with permission by the Owner, perform additional explorations not ordered by the Engineer.

D. Perform test pits in accordance with the requirements of Section 02315. Excavate the bottom 2 feet of the test pit (or in close proximity to known or anticipated utilities) by hand. Excavate to top of pipelines by hand. The Test pit work shall be performed to safely excavate and examine the structure or utility to be exposed without damaging existing utilities, including bracing, sheeting and dewatering the excavation, as necessary.

E. Measure the depth to the top of the pipeline, as well as to adjacent utilities, from the ground surface, at each test pit location. Record location, depth and size of pipelines and utilities uncovered during the test pits. Record any other pertinent information which is learned as a result of excavating the test pit.

F. Excavate test pits of an appropriate size with equipment suitable for the location and character of the pit to be excavated.

G. All subsurface investigations shall be conducted in accordance 29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.650 through 1926.652 including Appendices A through F.

H. After observation by the Engineer, backfill and compact the test pits in accordance with Section 02315.

I. Borings or other drilled probes shall be filled in their entirety with grout upon completion.

J. Repair damage to any structure, utility, or site feature on private or public property damaged during the Work to the satisfaction of the Engineer.

K. Repair paved surfaces in accordance with Section 02740.

L. Repair lawn areas or grass surfaces in accordance with 02920.

END OF SECTION

SECTION 02225

SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Demolition of ancillary structures and items within the Limit of Work indicated on the Drawings, but not specifically shown, such as concrete and bituminous pavement, drainage structures, utility infrastructure, fencing, curbing, landscaping, observation deck, signage and similar items, interior wall partition and bathroom fixtures in gatehouse building

2. Removal and lawful disposal of miscellaneous debris and solid waste located within the Limit of Work indicated on the Drawings

B. Related Sections

1. Section 02280 – Pipeline and Underground Structure Abandonment

2. Section 02315 - Excavation, Backfill, Compaction and Dewatering

3. Section 02925 – Site Restoration

1.2 DEFINITIONS

A. Demolish – To tear down, segregate waste streams and lawfully recycle or dispose of all debris generated in the process including structure contents.

B. Limit of Work – Area delineated on Drawings that defines the extent of demolition work under the Contract.

1.3 SUBMITTALS

A. Informational Submittals

1. Methods of demolition and equipment proposed to demolish structures. This submittal should be sufficient to demonstrate a thorough understanding of the Work to be completed and the means that will be implemented to safely complete the demolition within the Contract Time without damage to surrounding structures or resources.

2. Waste Management Plan to indicate the types of wastes to be generated and the proposed disposal or recycling locations. Include back-up disposal facilities.

3. Copies of any authorizations and permits required to perform the Work, including disposal/recycling facility permits.

B. The following records and disposal documentation must be maintained and kept current throughout the Project. These documents will be maintained in chronological order in a 3-ring binder with appropriate tabbed dividers. The binder will be reviewed for completeness at each progress meeting. Requests for periodic payments may be rejected, in whole or in part, if documentation is not current.

1. Records of the amounts of waste generated, by waste type

2. Evidence of lawful disposal or recycling of all wastes generated

3. Documentation of underground structures and utilities

4. Copies of any analytical results generated as a result of waste stream characterization

1.4 REGULATORY REQUIREMENTS

A. Contractor is solely responsible for obtaining permits or approvals which may be required to perform the work of this section, including all costs, fees and taxes required or levied

B. Notify and obtain such permits or approvals from agencies having jurisdiction over demolition prior to starting work.

C. Comply with all applicable federal, state, and local environmental, safety and health requirements regarding the demolition of structures and other site features and recycling or disposal of demolition debris, as applicable, including, EPA's Notice of Intent covered under a General Permit for Construction Activity, and preparation of a site-specific Stormwater Pollution Prevention Plan.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 PROJECT MANAGEMENT

A. Provide a full-time Project Superintendent who shall serve as a direct communication among the Contractor, subcontractors, and the Owner.

B. Require all subcontractors to provide a foreman or superintendent. That individual must be on site at all times that the subcontractor is working.

3.2 EXAMINATION

A. Verify site conditions before proceeding with demolition work. Field check the accuracy of the Drawings and inspect structures and utilities prior to start of work and notify the Engineer in writing, of any hazardous conditions and/or discrepancies. Primary structures and other site features are shown on the Drawings, other smaller structures, including, but not limited to, concrete walks and pads, miscellaneous signs, lamp posts, railings, and fencing may not be shown on the Drawings, but may exist within the Limit of Work and shall be demolished.

1. Unknown Site Conditions - The information provided on the Drawings and in the Specifications is believed accurate. Field verify all information. Bear full responsibility for obtaining all locations of underground structures, utilities and their connections. Maintain services to buildings outside the limits of work.

2. Interior Elements - Interior features including but not necessarily limited to structural elements, walls, partitions, equipment, piping or other building facilities are not shown on the drawings and must be visually inspected Inspect and appraise all features and facilities to be demolished or removed for salvage. Investigate to assure the condition of the work to be demolished and take all precautions necessary to ensure safety of people and property.

3.3 PREPARATION

A. Remove and/or stabilize all overhead hazards, prior to commencing work near any building. Where hazards cannot be stabilized, mark and control areas below hazards to prohibit access below the hazards. This shall be performed with caution tape, saw horses, safety fence or other types of barricades as determined by applicable safety codes. Similarly, all holes through the floors or weak sections of the floor shall either be covered or clearly marked to prohibit entry. Floor coverings shall be capable of supporting heavy equipment use.

B. Terminate and discontinue utilities serving the individual structures to be demolished, prior to demolition in accordance with Section 02280.

C. Plug and abandon all sewer lines and sewer manholes as indicated on Drawings before any plumbing fixtures or traps are removed from buildings.

3.4 HAZARDOUS MATERIALS

A. Lead Paint

1. A number of state, federal and local agencies regulate work which involves lead paint. Paint coatings on the structures to be demolished that contain lead. This lead could present a hazard to workers and requires regulatory compliance with 29 CFR 1926.62 "Lead in Construction."

2. Of specific concern is the cutting of steel components using torch methods. If the Contractor intends to torch cut painted steel, lead paint must be removed from the area to be cut with a chemical stripper or other means prior to cutting. Sufficient paint must be removed from the area to prevent volatilization of lead during the heating of the steel. Other means of controlling worker exposure to lead will be acceptable provided that they are addressed in the Lead Exposure Control Plan and that they meet the requirements of 29 CFR 1926.62.

3. Where activities may generate leaded dust or impact a leaded surface, regulate work area so that dust migration is contained properly within the regulated area. Once the work is complete, properly clean up and dispose of leaded dust and materials.

B. Oil and Hazardous Material Contamination

1. There is no known soil contamination at the site. However, contaminated soil may be encountered during excavation.

2. Contractor personnel working in areas of the site where contamination is likely to be encountered shall be appropriately trained

3. When working in areas of the site where contamination is likely to be encountered, Contractor’s Site Safety Officer shall monitor the work area.

3.5 BITUMINOUS CONCRETE PAVEMENT REMOVAL

A. Remove or reclaim bituminous concrete pavement within Limit of Work as indicated on the Drawings. Legally dispose of bituminous concrete pavement underlain with concrete off site along with the underlying concrete.

3.6 DISPOSAL

A. Legally dispose of or recycle all materials from demolition as well as equipment and other materials that are within the buildings. The disposal site shall be permitted to accept the waste stream by the applicable State Agency. Perform the loading of demolition materials in a manner that prevents materials and activities from generating excessive dust and ensures minimum interference with roads, sidewalks and streets both onsite and offsite.

B. Provide evidence that the demolition materials have been received at a legal disposal, recycle, reuse or salvage location. Such proof may include truck weigh slips from an approved disposal facility or documentation of transfer of title. Transport of all materials off site shall be in accordance with applicable Department of Transportation Regulations. All materials leaving the site shall become the property of the Contractor.

3.7 SITE RESTORATION

A. Prior to any backfilling, document the location of any structures that remain in place through construction photographs and by obtaining swing ties to and elevations of any structures to be buried. Progress payments may be withheld if current documentation is not maintained.

B. Backfill areas from which structures were removed to match the surrounding grade or to achieve the final grades indicated on the Drawings. Backfilling shall be conducted in accordance with Section 02315.

C. Restore damaged areas of the site and stabilize slopes in accordance with the erosion and sedimentation control requirements of the Contract and the stormwater permit.

D. Restore all disturbed areas in accordance with Section 02925.

END OF SECTION

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SECTION 02280

PIPELINE AND UNDERGROUND STRUCTURE ABANDONMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Abandonment of pipe

B. Related Sections

1. Section 02320, Borrow Material

1.2 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and methods required for proper performance of the work in this section.

B. Use equipment of adequate size, capacity and quantity to accomplish the work of this Section in a safe timely manner.

C. Comply with the directions of the Engineer and the requirements of governmental agencies having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Gravel borrow shall meet the requirements of Section 02320, Borrow Material.

B. Concrete shall have a 28-day compressive strength of 3000 psi and a maximum stone size of 1½ inches.

PART 3 EXECUTION

3.1 ABANDONING SANITARY SEWERS

A. Abandon existing pipelines upon completion of installation and successful testing of the new pipelines, manholes and appurtenances.

B. Seal gravity pipes that are to be abandoned at each end with a concrete plug not less than 1½ times the pipe diameter long in the barrel of the pipeline. For example, a 10-inch diameter pipe will require that a minimum 15-inch long plug be installed. Similarly, open ends of pressure sewers to be abandoned shall be sealed with a concrete plug no less than 1½ times the pipe diameter long in the barrel of the pipeline.

3.2 REPAIR/RESTORATION

A. Match surface repairs to its immediate surrounding area. Complete this work in accordance with the applicable specification section.

END OF SECTION

SECTION 02315

EXCAVATION, BACKFILL, COMPACTION AND DEWATERING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Excavation, backfill and compaction for subsurface utilities

B. Related Sections

1. Section 02210 - Subsurface Investigations

2. Section 02320 - Borrow Materials

1.2 REFERENCES

A. ASTM D1557-07 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))

B. Federal Register 40 CFR Part 122, United State Environmental Protection Agency (USEPA) Administered Permit Programs (National Pollution Discharge Elimination System or NPDES), Storm Water Discharge

C. ASTM D1556-07 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

D. ASTM D2487-06e1 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)

E. ASTM D6938-08a - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

F. 29 CFR Part 1926 Subpart P - OSHA Excavation Regulations 1926.650 through 1926.652 including Appendices A through F

G. 520 CMR 14.00 Excavation and Trench Safety

H. Commonwealth of Massachusetts Highway Department “Standard Specifications for Highways and Bridges,” 1988 Edition as amended

1.3 DEFINITIONS

A. Benching - A method of protecting employees from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

B. Earth Retention Systems - Any structural system, such as sheeting and bracing or cofferdams, designed to retain in-situ soils in place and prevent the collapse of the sides of an excavation in order to protect employees and adjacent structures.

C. Excavation - Any man-made cut, cavity, trench, or depression in an earth surface, formed by earth removal.

D. Protective System - A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include earth retention systems, sloping and benching systems, shield systems, and other systems that provide the necessary protection.

E. Registered Professional Engineer - A person who is registered as a professional engineer in the state where the work is to be performed. However, a professional engineer, registered in any state is deemed to be a "registered professional engineer" within the meaning of this standard when approving designs for "manufactured protective systems" or "tabulated data" to be used in interstate commerce.

F. Shield System - A structure that is designed to withstand the forces imposed on it by a cave-in and thereby protects employees within the structure. Shields can be permanent structures or can be designed to be portable and moved along as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with 29 CFR 1926.652(c)(3) or (c)(4). Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

G. Sloping - A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with differences in such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

H. Temporary Dewatering System – A system to lower and control water to maintain stable, undisturbed subgrades at the lowest excavation levels. Dewatering shall be provided for all pipelines, structures and for all other miscellaneous excavations.

I. Trench - A narrow excavation (in relation to its length) made below the surface of the ground, of at least three feet in depth. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 m).

1.4 SUBMITTALS

A. Performance data for the compaction equipment to be utilized

B. Modified Proctor Test (ASTM D1557) results and soil classification (ASTM D2487) for all proposed backfill materials at the frequency specified below:

1. For suitable soil materials removed during Excavation, perform one test for every 1,000 cubic yards of similar soil type. Similarity of soil types will be as determined by the Engineer.

2. For borrow materials; perform tests at frequency specified in Section 02320, Borrow Materials.

C. Compaction test results (i.e. ASTM D6938 or ASTM D1556) at a frequency of one test for every 100 cubic yards of material backfilled or at a minimum of one test per lift. The Engineer will determine the locations and lifts to be tested. The Contractor shall plan his operations to allow adequate time for laboratory tests and to permit taking of field density tests during compaction.

1. Methods and equipment proposed for compaction shall be subject to prior review by the Engineer. Compaction generally shall be done with vibrating equipment. Static rolling without vibration may be required by the Engineer on sensitive soils

that become unstable under vibration. Displacement of, or damage to existing utilities or structure shall be avoided. Any utility or structure damaged thereby shall be replaced or repaired as directed by the Engineer.

2. Additional compaction testing may be required when there is evidence of a change in the quality of moisture control or the effectiveness of compaction.

   a. Any costs associated with correcting and retesting as a result of a failure to meet compaction requirements shall be borne by the Contractor.

3. If all compaction test results within the initial 25% of the total anticipated number of tests indicate compacted field densities equal to or greater than the project requirements, the Engineer may reduce frequency of compaction testing. In no case will the frequency be reduced to less than one test for every 500 cubic yards of material backfilled.

4. The Contractor is cautioned that compaction testing by nuclear methods may not be effective where trenches are so narrow that trench walls impact the attenuation of the gamma radiation, when adjacent to concrete that impacts the accuracy of determining moisture content, or where oversize particles (i.e. large cobbles or coarse gravels) are present. In these cases, other field density testing methods may be required.

1.5 QUALITY ASSURANCE

A. All Excavation, Trenching, and related Earth Retention Systems shall comply with the requirements of OSHA excavation safety standards (29 CFR Part 1926 Subpart P), 520 CMR 14.00, and other State and local requirements. Where conflict between OSHA and State regulations exists, the more stringent requirements shall apply.

1.6 PROJECT CONDITIONS

A. Notify Dig Safe and obtain Dig Safe identification numbers.

B. Notify utility owners in reasonable advance of the work and request the utility owner to stake out on the ground surface the underground facilities and structures. Notify the Engineer in writing of any refusal or failure to stake out such underground utilities after reasonable notice.

C. Make explorations and Excavations to determine the location of existing underground structures, pipes, house connection services, and other underground facilities in accordance with Paragraph 3.2.D of this Section.

D. In accordance with 520 CMR 14.00, no person shall, except in an emergency, make an excavation in any public way, public property, or privately owned land until a permit is obtained from the appropriate designated permitting authority. For this project, the permit should be obtained from the Town of Barnstable.

PART 2 PRODUCTS

2.1 SOIL MATERIALS

A. Fill material is subject to the approval of the Engineer and may be either material removed from excavations or borrow from off site. Fill material, whether from the excavations or from borrow, shall be of such nature that after it has been placed and properly compacted, it will make a dense, stable fill.

B. Satisfactory fill materials shall include materials classified by ASTM D 2487 as GW, GP, GM, GP-GM, GW-GM, GC, GP-GC, SW, and SP. Additional requirements are included in Section 02320.

C. Satisfactory fill materials shall not contain trash, refuse, vegetation, masses of roots, individual roots more than 18 inches long or more than 1/2 inch in diameter, or stones over 6 inches in diameter. Unless otherwise stated in the Contract Documents, organic matter shall not exceed minor quantities and shall be well distributed.

D. Satisfactory fill materials shall not contain frozen materials nor shall backfill be placed on frozen material.

E. Excavated surface and/or pavement materials such as gravel or trap rock that are salvaged may be used as a sub-grade material, if processed to the required gradation and compacted to the required degree of compaction. In no case shall salvaged materials be substituted for the required gravel base.

2.2 DEWATERING MATERIALS

A. Provide silt filter bags (Dandy Dewatering Bag, Dirtbag, JMP Environ-Protection Filter Bag, or equal) of adequate size to match flow rate.

PART 3 EXECUTION

3.1 PREPARATION

A. Public Safety and Convenience

1. Adhere to the requirements of 520 CMR 14.00 for all excavation work.

2. Take precautions for preventing injuries to persons or damage to property in or about the Work.

3. Provide safe access for the Owner and Engineer at site during construction.

4. Do not obstruct site drainage, natural watercourses or other provisions made for drainage.

3.2 CONSTRUCTION

A. Earth Retention Systems

1. Provide Earth Retention Systems necessary for safety of personnel and protection of the Work, adjacent work, utilities and structures.

2. Maintain Earth Retention Systems for the duration of the Work.

3. Sheeting

a. Systems shall be constructed using interlocking corner pieces at the four corners. Running sheet piles by at the corners, in lieu of fabricated corner pieces, will not be allowed.

b. Drive sheeting ahead of and below the advancing excavation to avoid loss of materials from below and from in front of the sheeting.

c. Sheeting is to be driven to at least the depth specified by the designer of the earth retention system, but no less than 2 feet below the bottom of the Excavation.

4. Remove earth retention system, unless designated to be left in place, in a manner that will not endanger the construction or other structures. Backfill and properly compact all voids left or caused by the withdrawal of sheeting.

    a. Remove earth retention systems, which have been designated by the Engineer to be left in place, to a depth of 3 feet below the established grade.

B. Excavation

1. Perform excavation to the lines and grades indicated on the Drawings. Backfill unauthorized over-excavation in accordance with the provisions of this Section.

2. Excavate with equipment selected to minimize damage to existing utilities or other facilities. Hand excavate as necessary to locate utilities or avoid damage.

3. Sawcut the existing pavement in the vicinity of the excavation prior to the start of excavation in paved areas, so as to prevent damage to the paving outside the requirements of construction.

4. Perform excavation in such a manner as to prevent disturbance of the final subgrade. The Engineer or Owner may require the final six inches of excavation be performed by hand, with the use of a smooth-faced bucket, or other means acceptable to the Engineer or Owner, at no additional cost if subgrade disturbance is considered excessive as judged by the Engineer or Owner.

5. During excavation, material satisfactory for backfill shall be stockpiled in an orderly manner at a distance from the sides of the excavation equal to at least one half the depth of the excavation, but in no case closer than 2 feet.

    a. Excavated material not required or not suitable for backfill shall be removed from the site.

    b. Perform grading to prevent surface water from flowing into the excavation.

    c. Pile excavated material in a manner that will endanger neither the safety of personnel in the excavation nor the Work itself. Avoid obstructing sidewalks and driveways.

    d. Hydrants under pressure, valve pit covers, valve boxes, manholes, curb stop boxes, fire and police call boxes, or other utility controls shall be left unobstructed and accessible until the Work is completed.

6. Grade or create berms or swales to direct surface water from excavations to appropriate structures designed to accommodate storm water. If no structures exist, direct water to areas that minimize impacts to adjacent structures and properties.

7. Make pipe trenches as narrow as practicable and keep the sides of the trenches undisturbed until backfilling has been completed. Provide a clear distance of 12 inches on each side of the pipe.

8. Perform the excavation in such a manner as to prevent disturbance of the final subgrade. If excessive subgrade disturbance is occurring, as judged by the Owner or Engineer, then the final 6 inches of the excavation shall be performed

by hand, with the use of a smooth-faced bucket, or other means acceptable to the Engineer or Owner.

a. Grade the excavation bottom to provide uniform bearing and support for the bottom quadrant of each section of pipe.

b. Excavate bell holes at each joint to prevent point bearing.

c. Remove stones greater than 6 inches in any dimension from the bottom of the trench to prevent point bearing.

9. If satisfactory materials are not encountered at the design subgrade level, excavate unsatisfactory materials to the depth directed by the Engineer and properly dispose of the material. Backfill the resulting extra depth of excavation with satisfactory fill materials and compact in accordance with the provisions of this Section. Soil sampling shall be the responsibility of the Contractor is required.

C. Backfill and Compaction

1. Unless otherwise specified or indicated on the Drawings, use satisfactory material removed during excavation for backfilling trenches. The Engineer may require stockpiling, drying, blending and reuse of materials from sources on the Project. Soil sampling shall be the responsibility of the Contractor if required.

2. Spread and compact the material promptly after it has been deposited. When, in the Engineer's judgment, equipment is inadequate to spread and compact the material properly, reduce the rate of placing of the fill or employ additional equipment.

3. Prior to backfilling or placement of structures, excavated subgrades shall be proof compacted with either 10 passes of a 10-ton vibratory drum roller for open excavations or 6 passes of a large, reversible, walk behind vibratory compactor capable of exerting a minimum force of 2,000 pounds in trench or pit excavations. Soft or weak spots shall be over-excavated and replaced with compacted Granular Fill or compacted Crushed Stone wrapped in a non-woven geotextile, as directed by the Owner or their representative. If proof compaction will prove detrimental to the subgrade due to the presence of groundwater, static rolling may be allowed at the discretion of the Engineer or Owner.

4. Soil bearing surfaces shall be protected against freezing and the elements before and after concrete placement. If construction is performed during freezing weather, structures shall be backfilled as soon as possible after they are constructed. Insulating blankets or other means shall be used for protection against freezing at the discretion of the Engineer or Owner.

5. When excavated material is specified for backfill and there is an insufficient amount of this material at a particular location on the Project due to rejection of a portion thereof, consideration will be given to the use of excess material from one portion of the Project to make up the deficiency existing on other portions of the Project.

a. Use borrow material if there is no excess of excavated material available at other portions of the Project.

6. Backfilling and compaction methods shall attain 95% of maximum dry density at optimum moisture content as determined in accordance with ASTM D1557.

7. Do not place stone or rock fragment larger than six inches in greatest dimension in the backfill.

8. Maximum loose lift height for backfilling existing or borrow material shall be 12 inches, unless satisfactory compaction is demonstrated otherwise to the Engineer through field-testing. In no case shall loose lift height for backfilling exceed 3 feet.

9. Do not drop large masses of backfill material into the trench endangering the pipe or adjacent utilities.

10. Install pipe in rock excavated trenches on a dense graded stone bedding with a minimum depth of 6 inches. Shape the stone bedding at the pipe bells to provide uniform support. Encase the pipe in the dense graded crushed stone bedding to a grade 6 inches over the top of the pipe and 12 inches on each side of the pipe.

11. Backfill from the bottom of the trench to the centerline of the pipe with the specified material. This initial backfill is to be placed in layers of no more than 6 inches and thoroughly tamped under and around the pipe. This initial backfilling shall be deposited in the trench for its full width on both sides of the pipe, fittings and appurtenances simultaneously.

12. Electrical conduit not encased in concrete, shall be backfilled with sand borrow conforming to the requirements of Section 02320. The backfill shall be placed in the trench for its full width and shall extend to 12 inches over the conduit.

13. Where excavation is made through permanent pavements, curbs, paved driveways, or paved sidewalks, or where such structures are undercut by the excavation, place the entire backfill to sub-grade with granular materials and compact in 6 inch layers. Use approved mechanical tampers for the full depth of the trench. If required, sprinkle the backfill material with water before tamping so as to improve compaction. Any trenches improperly backfilled, or where settlement occurs, shall be reopened to the depth required to correct the problem, and shall then be refilled and properly compacted with the surface restored to required grade at no additional expense.

14. The Contractor shall not place backfill against or on structures until they have attained sufficient strengths to support the loads to which they will be subjected, without distortion, cracking, or other damage. As soon as possible after the structures are adequate, they shall be backfilled with suitable backfill material.

15. Place and compact backfill around manholes, vaults, pumping stations, gate boxes or other structures in six inch layers, from a point one foot over the pipe. Exercise care to protect and prevent damage to the structures.

D. Test Pit Excavation

1. General requirements of test pits are specified in Section 02210.

E. Dewatering

1. Provide, operate and maintain adequate pumping, diversion and drainage facilities in accordance with the approved dewatering plan to maintain the

excavated area sufficiently dry from groundwater and/or surface runoff so as not to adversely affect construction procedures nor cause excessive disturbance of underlying natural ground. Locate dewatering system components so that they do not interfere with construction under this or other contracts.

2. Conduct operations so as to prevent at all times the accumulation of water, ice and snow in excavations or in the vicinity of excavated areas so as to prevent water from interfering with the progress or quality of the work.

3. Take actions necessary to ensure that dewatering discharges comply with permits applicable to the Project. Dispose of water from the trenches and excavations in such a manner as to avoid public nuisance, injury to public health or the environment, damage to public or private property, or damage to the work completed or in progress.

4. Repair any damage resulting from the failure of the dewatering operations and any damage resulting from the failure to maintain all the areas of work in a suitable dry condition.

5. Exercise care to ensure that water does not collect in the bell or collar holes to sufficient depth to wet the bell or collar of pipes waiting to be jointed.

6. Take precautions to protect new work from flooding during storms or from other causes. Control the grading in the areas surrounding all excavations so that the surface of the ground will be properly sloped to prevent water from running into the excavated area. Where required, provide temporary ditches for drainage. Upon completion of the work, all areas shall be restored to original condition.

7. Brace or otherwise protect pipelines and structures not stable against uplift during construction.

8. Do not excavate until the dewatering system is operational and the excavation may proceed without disturbance to the final subgrade.

9. Unless otherwise specified, continue dewatering uninterrupted until the structures, pipes, and appurtenances to be installed have been completed such that they will not float or be otherwise damaged by an increase in groundwater elevation.

10. Temporarily lower the groundwater level at least two feet below excavations to limit potential “boils,”loss of fines, or softening of the ground. If any of these conditions are observed, submit a modified dewatering plan to the Engineer within 48 hours. Implement the approved modified plan and repair any damage incurred.

11. When subgrades are soft, weak, or unstable due to improper dewatering techniques, remove and replace the materials in accordance with Section 02320 at no cost to the Owner.

12. Notify the Engineer immediately if any settlement or movement is detected of survey points adjacent to excavations being dewatered. If settlement is deemed by the Engineer to be related to the dewatering, submit a modified dewatering plan to the Engineer within 24 hours. Implement the approved modified plan and repair any damage incurred to the adjacent structure at no cost to the Owner.

13. Dewatering discharge:

a. Install sand and gravel, or crushed stone, filters in conjunction with sumps, well points, and/or deep wells to prevent the migration of fines from the existing soil during the dewatering operation.

b. Do not discharge water into any sanitary sewer system.

c. Provide separately controllable pumping lines.

d. The Engineer reserves the right to sample discharge water at any time.

14. Removal

a. Do not remove dewatering system without written approval from the Engineer.

b. Backfill and compact sumps or ditches with screened gravel or crushed stone in accordance with Section 02320.

c. Remove well points and deep wells. Backfill abandoned well holes with cement grout having a water cement ratio of 1 to 1 by volume.

3.3 PROTECTION

A. Protection of Existing Structures

1. All existing foundations, conduits, wall, pipes, wires, poles, fences, property line markers and other items which the Engineer decides must be preserved in place without being temporarily or permanently relocated, shall be carefully supported and protected from damage by the Contractor. Should such items be damaged, they shall be restored by the Contractor to at least as good condition as that in which they were found immediately before the Work began.

B. Accommodation of Traffic

1. Streets and drives shall not be unnecessarily obstructed. The Contractor shall take such measures at his own expense to keep the street or road open and safe for two-way traffic unless otherwise indicated.

2. Construct and maintain such adequate and proper bridges over excavations as may be necessary or as directed for the safe accommodation of pedestrians and vehicles. Provide substantial barricades at crossings of trenches, or along the trench to protect the traveling public.

3. Where deemed necessary, such additional passageways as may be directed shall be maintained free of such obstructions. All material piles, open excavations, equipment, and pipe which may serve as obstructions to traffic shall be protected by proper lights, signage, or guards as necessary.

4. All traffic controls shall be in accordance with the Manual on Uniform Traffic Control Devices for Streets and Highways, latest edition.

C. Erosion and Sedimentation Control

1. Take all necessary steps to prevent soil erosion.

2. Plan the sequence of construction so that only the smallest practical area of land is exposed at any one time during construction.

3. Temporary vegetation and/or mulching shall be used to protect critical areas exposed during construction as judged by the Engineer.

END OF SECTION

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SECTION 02317

UNDERGROUND WARNING TAPE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Underground Warning Tape

1.2 SUBMITTALS

A. Shop Drawing Submittals

1. Product Data

PART 2 PRODUCTS

2.1 MATERIALS

A. Metallic warning tape for underground piping shall be polyethylene tape with metallic core for easy detection and location of piping with a metal detector.

B. Tape shall be 6 inches wide.

C. Tape shall be as manufactured by Seton Name Plate Corp., New Haven, CT; Presco Detectable Underground Warning tape, Sherman, Texas; Blackburn Manufacturing, Neligh, NE; Mercotape, Hachensach, NJ; or equal.

D. The warning tape shall be heavy gauge 0.004 inch polyethylene and shall be resistant to acids, alkalis and other soil components. It shall be highly visible in the following colors with the associated phrases stamped in black letters and repeated at a maximum interval of 40 inches.

Type of Utility	Color	Warning Message
Sanitary Sewer	Green	CAUTION - SANITARY SEWER BURIED BELOW
Storm Drain	Green	CAUTION - STORM DRAIN BURIED BELOW
Water	Blue	CAUTION – WATER LINE BURIED BELOW
Electric	Red	CAUTION – ELECTRIC LINE BURIED BELOW
Telephone / Communications	Orange	CAUTION – TELEPHONE LINE BURIED BELOW
Gas	Yellow	CAUTION – GAS LINE BURIED BELOW

E. The tape shall be of the type specifically manufactured for marking and locating utilities.

PART 3 EXECUTION

3.1 INSTALLATION

A. All buried pipe and fittings shall be installed with metallic-lined underground warning tape located no more than 24 inches below final grade to allow detection by a metal detector.

END OF SECTION

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SECTION 02320

BORROW MATERIALS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Gravel Borrow
2. Processed Gravel Borrow for Pavement Sub-base
3. Granular Fill
4. Sand Borrow for Dune Enhancement
5. Sand Borrow
6. Stone Borrow
7. Porous Pavement Subbase
8. Ordinary Borrow

B. Related Sections

1. Section 02315 – Excavation, Backfill, Compaction and Dewatering

1.2 REFERENCES

A. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

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

C. ASTM D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil using Standard Effort (12,400 ft-lbf/ft3)

D. ASTM D1556 - Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method

E. ASTM D1557 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lb./ft3)

F. ASTM D2434 - Standard Test Method for Permeability of Granular Soils (Constant Head)

G. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System)

H. ASTM D6938 - Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)

I. AASHTO – Standard Specification for Transportation Materials and Methods of Sampling and Testing, 1986 Edition as amended

J. Commonwealth of Massachusetts Highway Department “Standard Specification for Highways and Bridges,” 1988 Edition as amended

1.3 SUBMITTALS

A. Representative Samples of borrow materials taken from the source. Tag, label, and package the Samples as requested by Engineer. Provide access to the borrow site for field evaluation and inspection.

B. Provide sieve analysis (ASTM C136) and permeability analysis (ASTM D2434) from certified soils testing laboratory for all borrow materials.

1. Take and test a sample, at no additional cost to the Owner for each 1,500 c.y. of borrow material placed, except for borrow material for dune enhancement.

2. Take and test a sample, at no additional cost to the Owner for each 5,000 c.y. of dune enhancement borrow material placed.

C. Provide modified proctor analysis (ASTM D1557) from certified soils testing laboratory for all borrow materials.

1. All other borrow materials shall be tested once unless more frequent testing is deemed necessary by the Engineer or Owner due to material variation.

D. The Engineer reserves the right to require more frequent testing than that which is specified above should the borrow characteristics change.

1.4 QUALITY ASSURANCE

A. No borrow shall be placed prior to the approval of Samples by the Engineer.

1.5 PROJECT/SITE CONDITIONS

A. Existing Conditions

1. Comply with any environmental requirements and restrictions.

2. Keep all public and private roadway surfaces clean during hauling operations and promptly and thoroughly remove any borrow or other debris that may be brought upon the surface before it becomes compacted by traffic. Frequently clean and keep clean the wheels of all vehicles used for hauling to avoid bringing any dirt upon the paved surfaces.

PART 2 PRODUCTS

2.1 GRAVEL BORROW

A. Gravel Borrow shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings, crushed concrete, and deleterious materials. The coarse aggregate shall have a percentage of wear, by the Los Angeles Abrasion Test, of not more than 50.

Gradation requirements for Gravel Borrow shall be determined by AASHTO-T11 and T27 and shall conform to the following:

Sieve	Percent Passing
½ inch	50 – 85
No. 4	40 – 75
No. 50	8 – 28

No. 200	0 - 10

Maximum size of stone in Gravel Borrow shall be 2 inches.

2.2 PROCESSED GRAVEL BORROW

A. The compacted Processed Gravel Borrow to be used for gravel access roads and pavement subbase, or other area where a firm, free-draining subgrade is needed shall consist of inert material that is hard, durable stone and coarse sand, free from loam and clay, surface coatings, crushed concrete, and deleterious materials. The coarse aggregate shall have a percentage of wear, by the Los Angeles Abrasion Test, of not more than 50.

B. Gradation requirements shall conform to the following:

Sieve	Percent Passing
3”	100
1 ½”	60 – 100
¾”	50 – 75
No. 4	30 – 60
No. 200	0 - 10

C. Stockpile the processed materials in such a manner to minimize segregation of particle sizes. All processed gravel shall come from approved stockpiles.

2.3 GRANULAR FILL

A. Granular Fill to be used as fill material to achieve gravel base grade beneath structures, pavement, or other area requiring structural fill shall consist of inert material that is hard, durable stone and sand, free from loam and clay, surface coatings and deleterious materials. The coarse aggregate shall have a percentage of wear, by the Los Angeles Abrasion Test, of not more than 50.

B. Gradation requirements for Granular Fill shall conform to the following:

	Percent by Weight Passing Through	
Sieve Size	**Minimum**	**Maximum**
2/3rds loose lift thickness	100	--
No. 10	30	95
No. 40	10	70
No. 200	0	15

2.4 SAND BORROW FOR DUNE ENHANCEMENT

A. Sand Borrow material shall be supplied from borrow area approved by the Engineer. Testing of the off-site Sand Borrow shall be at the Contractor’s expense.

B. Sand Borrow For Dune Enhancement shall consist of clean, inert, hard, durable grains, free from loam or clay, surface coatings, crushed concrete, and deleterious materials. The allowable amount of material passing a No. 200 sieve as determined by ASTM-C117 shall not exceed 1% by weight.

C. Material shall consist of a clean, non-plastic, granular material conforming to the requirements of a SW, SP or SM under the Unified Soil Classification System (USCS) (ASTM D2487).

D. Gradation requirements for Granular Fill shall conform to the following:

	Percent by Weight Passing Through	
Sieve Size	**Minimum**	**Maximum**
No. 10	100	100
No. 20	85	100
No. 40	20	80
No. 60	3	40
No. 100	1	5
No. 200	0.1	1

2.5 SAND BORROW

A. Sand Borrow material shall be supplied from an off-site borrow area approved by the Engineer. Testing of the off-site Sand Borrow shall be at the Contractor's expense.

B. Sand Borrow shall consist of clean, inert, hard, durable grains of quartz or other hard, durable, rock, free from loam or clay, surface coatings and deleterious materials. The allowable amount of material passing a No. 200 sieve as determined by ASTM-C117 shall not exceed 6% by weight.

C. Material shall consist of a clean, non-plastic, granular material conforming to the requirements of a SW, SP or SM under the Unified Soil Classification System (USCS) (ASTM D2487).

D. The material shall have the characteristics that when placed and compacted, the soil particles will bind together so as to form a solid, stable surface capable of supporting rubber-tired vehicular traffic during wet weather periods as well as extended dry weather periods. The borrow material shall not contain fines to the extent that the surface layer becomes "greasy" when wet.

E. Material consisting of frozen clogs, ice and snow will be rejected.

F. The sand borrow shall generally conform to the grading requirements shown in the following grading table.

	Percent by Weight Passing Through	
Sieve Size	**Minimum**	**Maximum**
2"	100	-
No. 4	70	100

No. 50	10	55
No. 100	2	10
No. 200	0	6

G. All sand borrow material to be used shall be subject to approval by Engineer, and Engineer reserves the right to reject any borrow material from the job that does not meet the above requirements.

2.6 STONE BORROW

A. Crushed Stone Borrow

1. Crushed stone borrow shall consist of one of the following materials:

   a. Durable crushed rock consisting of fragments obtained by breaking and crushing solid or shattered natural rock, and free from a detrimental quantity of thin, flat, elongated or other objectionable pieces. A detrimental quantity will be considered as any amount in excess of 15% of the total weight. Thin stones shall be considered to be such stones whose average width exceeds 4 times their average thickness. Elongated stones shall be considered to be stones whose average length exceeds 4 times their average width.

   b. Durable crushed gravel stone obtained by artificial crushing of gravel boulders or fieldstone with a minimum diameter before crushing of 8 inches.

2. The crushed stone shall be free from clay, loam or deleterious material and not more than 1.0% of satisfactory material passing a No. 200 sieve will be allowed to adhere to the crushed stone.

3. The crushed stone shall have a maximum percentage of wear as determined by the Los Angeles Abrasion Test (AASHTO-T-96) as follows:

   a. For Class 1 Bit. Conc. 30%**

   b. For Cement Concrete Aggregate 45%***

   c. Crushed Stone for Subbase 45%

   **Crushed stone for this use shall consist of crushed or shattered natural rock only.

   ***Except for 5000 psi or greater cement concrete and prestressed concrete which shall be 30%.

4. The crushed stone shall conform to the grading requirements shown in the following grading Table.

	Percent by Weight Passing Through	
Sieve Size	**Minimum**	**Maximum**
2" Crushed Stone		
2 1/2"	100	--

2”	90	100
1 ½”	35	75
1”	0	15
1/2 ”	0	5

1 ½” Crushed Stone		
2”	100	--
1 ½”	95	100
1”	35	70
¾”	0	25
¾” Crushed Stone		
1”	100	--
¾”	90	100
½”	10	50
3/8”	0	20
No. 4	0	5

5. Stone gradations shall vary depending on field use and shall be determined by Engineer.

B. Dense Graded Stone Borrow

1. The crushed stone used for backfill shall be a dense graded mixture and conform to the following gradation requirements.

Sieve Size (Square Openings)	**Percent by Weight Passing Through**	
	Minimum	**Maximum**
5/8″	100	100
½″	85	100
3/8″	15	45
No. 4	0	15
No. 8	0	5

C. Modified Rockfill

1. Stone used for modified rockfill shall meet the requirements of Article M2.02.4 “Modified Rockfill” as detailed in the “Massachusetts Specifications for Highways and Bridges”, 1988 edition and any revisions thereto. Modified rockfill shall consist of hard, durable, angular shaped stones which are the product of the primary crushing of a stone crusher. Rounded stone, boulders,

sandstone and similar soft stone or relatively thin slabs will not be acceptable. Stone shall be free from overburden, spoil, shale, and organic material and shall conform to the following gradation requirements:

	Percent Passing Through	
Stone Size	**Minimum**	**Maximum**
8″	95	100
4″	0	25
2½″	0	5

D. Washed Rounded Stone (Peastone)

1. All stone shall be clean material substantially free from any foreign and deleterious material such that not more than 1% passes the #200 sieve. The maximum particle size shall be 5/8″.

2. Washed rounded stone shall conform to the following gradation requirements:

	Percent Passing Through by Weight	
Sieve Size	**Minimum**	**Maximum**
5/8 ″	100	-
½″	85	100
3/8”	15	45
No.4	0	15
No.8	0	5

2.7 ORDINARY BORROW

A. Ordinary borrow shall have the physical characteristics of soils designated as type GW, GP, GM, SW, SP or SM, under USCS and shall not be specified as gravel borrow, sand borrow, special borrow material or other particular kind of borrow. It shall have properties such that it may be readily spread and compacted for the formation of embankments. The borrow shall not include rocks with a major dimension greater than 8 inches.

2.8 POUROUS PAVEMENT SUB BASE

1. The material for the sub base of the porous pavement shall conform to the following gradation requirements.

	Percent by Weight Passing Through	
Sieve Size (Square Openings)	**Minimum**	**Maximum**
1 1/2″	100	100
1”	95	100

1/2″	25	65
No. 4	0	10
No. 8	0	5

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to the placement of borrow material, site preparation shall be completed as required by the Contract Documents, and approved by the Engineer.

B. Ensure that all materials are properly stockpiled on site to prevent contamination by other materials.

C. Place borrow material over the entire area in uniform lifts and compact in accordance with Section 02315.

D. Utilize on-site soils prior to using off-site borrow provided on-site soils meet the requirements of the specifications.

E. Utilize gravel borrow in all locations where a surface treatment has not been specified but requires a firm finish surface.

F. Processed gravel for pavement subbase is intended to provide a stable foundation for driveways, sidewalk and roadway repair where a gravel base has been specified.

G. Borrow shall be used as a replacement for unsuitable materials where poor soil conditions are encountered during the progress of the work, where approved by the Engineer. Borrow type will be determined by the Engineer. Borrow material used as a replacement for unsuitable soil is not intended to be an aid to dewatering.

H. Shape borrow used for pipe foundation material so that it supports the pipe properly and will not damage the pipe, bells, collars, or the pipe fittings.

I. Place all borrow to keep it free of other materials and to prevent segregation.

J. Maintain and repair all eroded areas during the life of this contract at no additional cost to the Owner.

END OF SECTION

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SECTION 02457

HELICAL PILES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. This work shall consist of helical piles designed, furnished, installed, and tested in accordance with these specifications and as shown on the Contract Drawings.

2. Contractor shall perform subsurface investigation(s) consisting of soil borings to determine subsurface conditions for design of helical piles.

3. Helical Pile Brackets

B. Related Sections

1. Section 06100 – Heavy Timber Construction

2. Section 05500 – Miscellaneous Metals

1.2 REFERENCES

A. Massachusetts State Building Code, 9th Edition

B. International Building Code, 2015 Edition

C. ASTM A36 Standard Specification for Carbon Structural Steel

D. ASTM A53 Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

E. ASTM A153 Zinc Coating (Hot Dip) on Iron and Steel Hardware

F. ASTM A572 Standard Specification for High-Strength Low-Allow Columbium-Vanadium Structural Steel

G. ASTM D1143 Standard Test Methods for Deep Foundations Under Static Axial Compressive Load

H. ASTM D156 Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils

I. ASTM D3689 Standard Test Methods for Deep Foundations Under Static Axial Tensile Load

J. ASTM D3966 Standard Test Methods for Deep Foundations Under Lateral Load

K. AWS D1.1 Structural Welding Code – Steel

1.3 DEFINITIONS

A. Bearing Stratum – The undisturbed soil layer at any pile location which provides the axial resistance of an installed helical pile bearing on one or more of the pile helices.

B. Contractor - The person/firm responsible for performing the helical pile work.

C. Coupling - Central steel shaft connection to the extension shaft.

D. Coupling Bolts - High-strength, structural steel fasteners used to connect helical pile segments together.

E. Helical Extension - Helical pile foundation component installed immediately following the lead or starter section. This component consists of one or more helix plates welded to a central shaft. Its function is to increase bearing area.

F. Helix Plate - A round steel plate formed into a ramped spiral. The helical shape provides the means to install the helical pile, plus transfers load to the soil in end bearing.

G. Helical Pile - A bearing type foundation element consisting of a lead or starter section, helical extension (if required), plain extension section(s), and a steel cap plate.

H. Installation Torque (T) - The resistance generated by a helical pile when installed into the soil. The installation resistance is a function of the soil type, and the size and shape of the various components of the helical pile.

I. Lead Section - The first helical pile foundation component installed into the soil, consisting of single or multiple helix plates welded to a central steel shaft.

J. Plain Extension - Central steel shaft segment without helix plates. It is installed following the installation of the lead section or helical extension (if used). Plain extensions are used to extend the helix plates beyond the specified minimum depth and into competent load bearing stratum.

K. Safety Factor - The ratio of the ultimate capacity to the working or design load used for the design of the pile or structural element of the pile.

1.4 SUBMITTALS

A. Qualifications

1. Submit a list containing at least five projects on which the pile contractor has installed helical piles similar in size and complexity to this project within the past 5 years. A brief description of each project and a reference shall be included for each project listed. As a minimum, the reference shall include an individual's name, company name and address, and current phone number.

2. Submit a list identifying the Contractor’s Design Engineer, rig operators, and on-site supervisors who will be assigned to the project. The list shall contain a summary of each individual's experience. The helical pile work shall be performed under the direction of the Contractor’s Design Engineer. The Design Engineer shall have a minimum of 5 years of experience designing and directing the installation of helical piles, and shall be a licensed Massachusetts Professional Engineer. Equipment operators and on-site supervisors shall have a minimum of 1 year of experience installing helical piles with the pile contractor's organization, and a minimum of 5 years of experience installing helical piles.

3. The Engineer will approve or reject the pile contractor's qualifications and staff within 10 working days after receipt of the complete submittal. Work shall not be started on any piling nor any materials ordered until approval of the pile contractor's qualifications is given. The Engineer may suspend the pile work if the pile contractor substitutes unqualified personnel for approved personnel. The Contractor shall be fully liable for additional costs resulting from the suspension of work and no adjustment in contract time resulting from the suspension of work will be allowed.

B. Submit boring log(s) for boring(s) performed on which the helical pile design is based.

C. Submit a detailed narrative describing the pile installation method proposed and encompassing all aspects of the pile installation operation.

D. Submit working drawings and a design submission describing the helical piles proposed for use. The working drawings and design submission, stamped/sealed by the Design Engineer, shall be submitted 30 calendar days prior to the desired commencement of the pile installation. The working drawings and design submission shall include the following:

1. Pile design calculations stamped/sealed by a Massachusetts Professional Engineer, and properly coordinated with shop drawings. Calculations shall include:

    a. A written summary report which describes the overall helical pile design.

    b. Applicable code requirements and design references.

    c. Design criteria including soil shear strengths, unit weights, and bearing capacity factors values for each stratum.

    d. References for and/or calculations for soil unit weights, friction angles, and soil lateral resistance.

    e. Manufacturer's recommended capacity to installation torque ratio.

    f. Minimum final installation torque(s).

    g. Minimum pile installation depth / maximum pile termination elevation.

    h. Downdrag and buckling, as applicable.

    i. Lateral resistance of the shaft, if applicable.

    j. Estimated pile head movement at the design loads.

    k. Method for verifying pile capacity, such as correlation of installation torque, field load testing, or other methods.

2. Corrosion protection coating on piles and bracket assemblies.

3. A drawing showing the location and orientation of each helical pile and cross bracing. The locations of the pile to timber pile cap connections shall not be altered from what is shown on the design plans. Pile locations shall not interfere with any existing site features, including but not limited to structures, roadways, utilities, and equipment. A pile schedule providing:

    a. Pile number.

    b. Pile design load.

    c. Pile batter as required; and

    d. Type and size of pile.

4. Installation means and methods to ensure that loads are transferred to the bearing stratum. The submittal shall include general notes for constructing the helical piles, including construction sequencing and other special construction requirements.

5. Pile to timber pile cap connection details.

6. Fabricated bracing to pile connection details (if required).

7. The Engineer will acknowledge and respond to the Contractor's working drawings and design submission within 15 working days after receipt of the submission.

E. Submit mill test reports for the helical piles, including pipe thicknesses, dimensions, and steel type.

F. Submit mill test reports for the bracing and bracing brackets.

G. Submit calibration data for each test jack and pressure gauge. The calibration tests shall have been performed by an independent testing laboratory and test shall have been performed within 60 calendar days of the date submitted. Testing shall not commence until the Engineer has acknowledged receipt of satisfactory submittals for the jack and pressure gauge calibration.

H. Submit within 30 calendar days after completion of the helical pile work a report containing:

1. As-built drawings showing the surveyed locations of the piles, the pile lengths, and surveyed pile tip elevations.

2. Detailed pile installation records for each pile including embedment depth of pile in the bearing stratum, helical pile type and configuration, installation equipment, type of torque indicator used, installation torque at one-foot intervals for the final 10 feet of installation, obstructions, plumbness, and variance from designed pile location and elevation.

3. Pile test results and graphs.

4. Certification from the Contractor's Design Engineer that piles were installed to sufficient depth, elevation, and capacity to achieve the design loads.

I. Manufacturer's literature including technical and performance specifications of the pile installation equipment. Submit copies of calibration reports for each torque indicator or torque motor. The calibration tests shall have been performed within 45 days of the date submitted. The calibration reports shall include the name of the testing agency, the serial number of the device calibrated, a description of the calibration testing equipment, the calibration date, and calibration results.

1.5 DESIGN CRITERIA

A. Helical piles shall be designed in accordance with the Massachusetts State Building Code and meet the following requirements:

1. Minimum vertical and lateral service loads:

1) Compression: 9.5 kips (per pile)

2) Tension: 1 kip (per pile)

3) Lateral: 250 lbs (per pile)

4) As otherwise required by the Design Engineer.

2. All helical piles shall be designed to support the minimum design load(s) as specified herein.

3. Maximum settlement of piles shall not exceed 0.5 inch.

4. All helical pile components shall be selected to provide a minimum factor of safety against ultimate mechanical failure of 2.0.

5. The allowable geotechnical axial design load in compression shall be determined based on a minimum factor of safety of 2.0 applied to:

    a. The sum of the areas of the helical bearing plates multiplied by the ultimate bearing capacity of the soil or rock comprising the bearing stratum.

    b. The ultimate capacity as determined from well-documented correlations with installation torque.

    c. The ultimate capacity as determined from load tests.

    d. The ultimate capacity of the pile shaft.

    e. The ultimate axial capacity of pile shaft couplings.

    f. The sum of the ultimate axial capacity of helical bearing plates.

6. The allowable uplift capacity of a single helical pile shall be determined by an approved method of analysis based on a minimum factor of safety of 3.0, unless load tests are conducted, in which case the minimum factor of safety shall be 2.0.

7. The allowable lateral load capacity of a single helical pile or group thereof shall be determined by an approved method of analysis or by lateral load test. The allowable load shall be not more than half of the load which produces a gross lateral movement of 1 inch. The design lateral load capacity shall account for the combined effects of compression and bending, where applicable.

    a. The design shall not rely upon lateral resistance in the top 2 feet of soil.

8. The allowable working load on the helical piles shall not exceed the lesser of $0.6F_y$ or $0.5F_u$, where F_y is the specified minimum yield stress of steel and F_u is the specified minimum tensile stress of the steel.

9. The helical pile design shall take into account pile spacing, soil stratification, and strain compatibility.

10. The design submittal shall provide the minimum effective installation torque for each size and capacity pile.

11. The design shall consider the effects of adfreezing on helical piles that are in the frost zone. The design shall demonstrate that the helical piles in the frost zone have adequate resistance to prevent uplift from adfreezing.

12. The minimum depth of the lowest pile helix shall be at least 10 feet below finished grade, but may be deeper based on the Contractor's design. Where predrilling or excavation is performed to remove obstructions prior to pile installation, the piles shall be installed to a sufficient depth such that all helices bear within undisturbed soils.

1.6 ALLOWABLE TOLERANCES

A. Centerline of helical pile shall be not more than 2.0 inches in either direction from indicated plan position.

B. Helical pile plumbness shall be within 2 degrees of design alignment.

C. Top elevation of installed helical pile shall be within 1 inch of the design vertical elevation.

1.7 QUALITY CONTROL

A. Field Monitoring and Testing

1. Install all piles in the presence of an authorized representative of the Owner.

2. Certification of quality of pile materials to be used in the Work shall be furnished at the time of delivery of materials to the site. Pile materials shall also be subject to on-site observation for conformance with Contract Documents.

3. Approvals given by the Engineer shall not relieve the Contractor of their responsibility for performing the Work in accordance with the Contract Documents.

B. The Owner's independent observer will observe installation of helical piles. Observation will include recording helical pile size, configuration, installation depth, and installation torque measurements.

C. The Contractor's Design Engineer or Design Engineer's representative shall observe installation of helical piles such that the Design Engineer can provide the installation records and certification required under section 1.4-H.

1.8 QUALITY ASSURANCE

A. Perform work in accordance with the International Building Code (current edition) as modified by the Massachusetts State Building Code (current edition).

B. Install helical piles in accordance with manufacturer and Design Engineer requirements.

1.9 PROJECT/SITE CONDITIONS

A. Existing Conditions

1. The Contractor shall examine the project site conditions, drawings, and existing utilities information.

2. Soil borings or other exploratory operations shall be performed by the Contractor to determine helical pile installation parameters at no additional cost to the Owner. Refer to section 3.1 of this specification.

1.10 SEQUENCING AND SCHEDULING

A. Provide fully equipped pile installation equipment in full-time operation at the site during the Work and mobilize additional equipment, if necessary, to complete the Work on schedule.

B. Piles located in areas to be excavated or demolished shall not be installed until the excavation and/or demolition has been completed.

C. Commence installing the initial pile(s) for the load test, if applicable, immediately upon mobilizing the pile installation equipment to the site.

D. Once the test pile(s) has been installed, tested, and approved, commence installation of production piles.

E. Coordinate pile installation operations with work by others on the project.

PART 2 PRODUCTS

2.1 MATERIALS

A. Pile Shafts

1. The central steel shaft, consisting of lead sections, helical extensions, and plain extensions, shall be square or round shaft structural steel conforming to ASTM A500, A513, A53, A242, or A618.

2. Helical piles shall be newly manufactured and shall be free of defects and corrosion.

B. Helix Bearing Plates

1. The helix bearing plates shall be hot-rolled carbon steel formed on matching metal dies to true helical shape and uniform pitch as required by the Contractor's pile design, conforming to ASTM A656, A1018, A36, or A572. Minimum plate thickness shall be 0.375 inches.

C. Coupling Bolts

1. Coupling bolts shall be of appropriate diameter, meeting ASTM A193, Gr. B7, or SAE J429, Gr. 5 or 8.

D. Couplers

1. Couplers shall be formed as an integral part of the plain and helical extension material as hot upset forged sockets or internal sleeve-wrought steel connectors.

E. Timber Pile Cap Connections

1. Helical piles terminated at timber pile caps shall be connected with a galvanized, three-sided steel bracket, as shown on the Drawings.

2. The pile head shall be fitted with fabricated bearing plate assembly. The assembly shall consist of a coupler sleeve bolted to the helical shaft and a welded base plate. Steel plate shall conform to ASTM A36 or A575 Gr. 50. Coupler sleeve shall be pipe and conform to ASTM A53 Gr. B or HSS conforming to ASTM A500 Gr. B.

3. Provide separation barrier between dissimilar metals.

F. Corrosion Protection

1. The helical piles, bracing, brackets, and all components thereof, shall be hot-dip galvanized after fabrication in accordance with ASTM A123, with a minimum of 5 mils coating thickness.

PART 3 EXECUTION

3.1 SUBSURFACE INVESTIGATIONS

A. Prior to subsurface investigations, delineate the scope of the boring(s) on the ground surface of the ground using white paint, or stakes or other suitable white markings on

non-paved surfaces and coordinate with the appropriate agencies in accordance MGL Chapter 82 Section 40. Pre-marking will not be acceptable if such marks can interfere with traffic or pedestrian control or are misleading to the general public.

B. Perform soil boring(s) in sufficient location, quantity and depth as required for the Contractor's Design Engineer. At minimum, perform at least one soil boring to a depth of at least 10 feet below the deepest helical pile helix. Perform Standard Penetration Tests (SPTs) at intervals not exceeding 5 feet in each boring performed.

C. Soil boring(s) shall be observed by the Contractor's Design Engineer or a representative of the Contractor's Design Engineer.

D. Borings shall be appropriately backfilled after completion to prevent any ground subsidence.

E. Repair damage to any structure, utility, or site feature on private or public property damaged during the Work to the satisfaction of the Engineer.

3.2 PREPARATION

A. Load, transport, unload, store, and handle piles so that the metal is kept clean and free from damage and distortion. Piles damaged during installation will not be accepted unless the capacity is proven to be 100 percent of the required ultimate capacity by load tests and the galvanization is undamaged. Perform load tests to prove capacity of damaged piles at no cost to the Owner.

B. Protect existing structures and utilities at all times.

C. Determine pile locations in the field and establish all elevations required.

D. The Contractor shall employ a licensed Massachusetts Professional Land Surveyor, familiar with pile installation, who shall establish lines and levels. The Contractor shall be responsible for correctly locating piles prior to installation and surveying final pile locations.

3.3 EQUIPMENT

A. Helical piles shall be installed using a rotary torque motor with clockwise and counterclockwise rotation capabilities. The torque motor shall be capable of continuous adjustment of the rotation rate during installation. The torque motor shall have a torque capacity that is at least 15% greater than the torsional strength rating of the central steel shaft to be installed.

B. A torque indicator shall be used during helical pile installation that provides continuous measurement of the applied torque. The torque indicator shall be capacity of torque measurements in increments of 500 foot-pounds or less.

C. Equipment shall be capable of applying adequate down pressure and torque simultaneously with continuous position adjustment to maintain pile alignment and to uniformly advance the helical pile sections approximately 3 inches per revolution.

D. Pre-boring and jetting shall not be used unless approved in writing by the Engineer.

3.4 INSTALLATION

A. Install all piles at the proper locations shown on the pile design submittal. Pile locations shall be checked during installation and appropriate measures taken, as necessary to maintain the correct pile location and orientation. Sufficient downward pressure shall

be applied to uniformly advance the helical pile sections approximately 3 inches per revolution. The rate of rotation and magnitude of downward pressure shall be adjusted for different soil conditions and depths.

B. Install piles to the designed minimum installation torque and to the depth necessary to obtain the required ultimate pile capacity. The torque as measured during installation shall not exceed the torsional strength rating of the central steel shaft.

C. If the designed minimum installation torque is not achieved at the designed minimum embedment depth, the Contractor shall do one of the following at no cost to the Owner:

1. Install the helical pile deeper using additional extension sections.

2. Remove the helical pile and install a new pile with additional and/or larger diameter helix plates. The pile designer shall submit the proposed new helix configuration prior to installation of the new pile. If the new pile is installed at the same location as the original pile, the top-most helix of the new helical pile shall be terminated at least 3 feet below the tip elevation of the original helical pile.

3. Install additional helical piles to provide the required capacity.

D. The average torque of the final 3 feet of penetration shall be used as the basis of comparison with the minimum installation torque provided in the design submittal. The average torque shall be defined as the average of the last three readings recorded at 1-foot intervals.

E. If the torsional strength rating of the central steel shaft and/or installation equipment is reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may cut said extension shaft to the correct elevation or remove the last plain extension and replace it with a short plain section. The Contractor shall not reverse (back-out) the helical pile to facilitate extension removal.

F. Immediately after installation of each pile, establish a reference point and its elevation on the pile for the purpose of checking movement of the pile as additional piles are installed.

G. Check for pile heave during installation operations. Take level readings immediately after each pile is installed and again after piles within a radius of 15 feet are installed. Reinstall all piles to the designed torque or penetration that heave more than ¼ inch.

H. Protect piles from damage at all times during and after installation.

3.5 OBSTRUCTIONS

A. The Contractor shall resort to all usual methods to install piles when obstructions are encountered within a depth of six feet beneath the surface of the existing ground surface. Such usual methods shall include excavation or auguring. No excavation or other method of by-passing obstructions may be utilized within the bearing strata of the helical bearing plates. If, in the judgment of the Owner's representative, the Contractor is unable to complete the proper installation of any pile by and after resorting to the above methods, the pile installation at that location shall be abandoned, and an additional pile or piles shall be installed.

B. Piles abandoned because of unknown obstructions encountered before reaching the bearing strata shall be removed. If the pile cannot be removed, then the abandoned pile shall be cut off or removed so as not to interfere with future construction. The

Contractor will be paid for the pile if the obstruction is encountered deeper than six feet and cannot be removed. Additional payment will be made for replacement piles in accordance with the General Conditions

3.6 TESTING

A. If required by the approved design submittal, a minimum of one test pile shall be loaded to the highest ultimate capacity for each pile size/configuration and orientation proposed, and for each soil strata present at the top of the pile. The load test results shall be evaluated by the Contractor for compliance with pile performance requirements and shall be submitted to the Engineer. Axial and lateral load testing of each capacity pile shall be considered one test.

B. Test piles shall be installed with the same equipment as the production piles.

C. The load shall be applied with a calibrated hydraulic jack. A leveling plate shall be attached to the surface of the test pile and the jack shall be set in position with the load centered on the pile.

D. Vertical Load Test

1. Perform vertical load testing in accordance with ASTM D1143, ASTM 3689, and the following.

a. The load test equipment shall be capable of increasing or decreasing the applied load in increments that provide the required percentage of the ultimate pile capacity.

b. The reaction system shall be designed to have sufficient strength and capacity to distribute the test loads to the ground. It shall be designed to prevent movement of the loading apparatus during testing and to prevent eccentric loading of the pile head. The direction of the applied load shall be collinear with the axis of the pile at all times.

c. Dial gauges shall be used to measure pile movement. The dial gauge shall have an accuracy of at least +/-0.001-inch and a minimum travel sufficient to measure all pile movements without resetting the gauge. The dial gauge shall be positioned so its stem is parallel with the axis of the pile. The stem shall rest on a smooth plate located at the pile head, perpendicular to the axis of the pile. The dial gauge shall be supported by a reference apparatus to provide an independent fixed reference point. Said reference apparatus shall be independent of the reaction system and shall not be affected by movement of the reaction system.

d. The hydraulic jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test shall not be required. The jack shall be positioned co-axially with the pile-head and shall be positioned to prevent eccentric loading. The hydraulic jack shall be capable of applying a load not less than two times the proposed design load (DL). The pressure gauge shall be graduated in 100 psi or smaller increments. The stroke of the jack shall not be less than the theoretical elastic shortening of the total pile length at the maximum test load.

e. An alignment load (AL) shall be applied to the pile prior to setting the deflection measuring equipment to zero or a reference position. The AL shall be no more than 10% of the design load (0.1 DL).

f. Axial compression or tension load tests shall be conducted by loading the pile incrementally as shown in the following table. Pile head deflection shall be recorded at the beginning of each step and after the end of the hold time. The beginning of the hold time shall be defined as the moment when the load equipment achieves the required load increment or decrement.

g. Test loads shall be applied until continuous jacking is required to maintain the load step or until the test load increment equals 200% of the service load (DL) (i.e., 2.0 DL), whichever occurs first. The observation period for this last load increment shall be 10 minutes. Displacement readings shall be recorded at 1, 2, 3, 4, 5 and 10 minutes.

h. The applied test load shall be removed in four approximately equal decrements as shown in the following table. The hold time for these load decrements shall be 1 minute, except for the last decrement, which shall be held for 5 minutes.

Load Testing Steps and Hold Times

Load Step	Hold Time (min.)
AL	1.0
0.20 DL	2.5
0.40 DL	2.5
0.60 DL	2.5
0.80 DL	2.5
1.0DL	2.5
0.75 DL	1.0
0.50 DL	1.0
0.25 DL	1.0
AL	1.0
0.5 DL	1.0
1.0 DL	1.0
1.2 DL	2.5
1.4 DL	2.5
1.6 DL	2.5
1.8 DL	2.5
2.0 DL	10.0
1.5 DL	1.0
1.0 DL	1.0
0.5 DL	1.0
AL	5.0

E. The test piles shall withstand loading at the compression and tension service capacities with no more than ½ inch of total vertical movement of the pile head relative to the pile head position prior to the start of testing.

F. Failure at the ultimate compression and tension capacities shall be defined by one of the following, whichever results in the lesser load:

1. The point at which the movement of the helical pile tip exceeds the elastic compression/tension of the pile shaft by 8% of the diameter of the largest helix.

2. The point at which the slope of the load versus deflection curve (at the end of the load increment) exceeds 0.05 inches/kip.

G. Lateral Load Test

1. Perform lateral load testing of piles in accordance with ASTM D3966.

H. The test pile may be used as a production pile provided it passes the load test. If the test pile fails to give acceptable results, the Contractor shall modify their design and install and test another pile at their expense. Remove test piles not incorporated into the completed Work to at least 2 feet below finished grade or 2 feet below the bottom of structures and utilities, whichever is deeper.

3.7 WARRANTY

A. The Contractor shall guarantee that they will repair or replace at their own expense all structural damage caused by inability of their piles to satisfactorily support the service loads for a period of two years.

3.8 SAFETY

A. The Contractor is responsible for the safe operation of pile installation equipment and maintenance of safe and controlled work area.

B. Never allow unauthorized or unqualified people to operate, maintain, or come within 100 feet of the equipment.

C. Pile installation equipment shall be inspected thoroughly before use. Any equipment that has any cracks, broken pieces, or thin wall sections that might break in use shall be rejected before installation begins. During use, equipment shall be inspected frequently for developing cracks or broken or missing pieces, and removed from the job if any of these is discovered during inspection.

END OF SECTION

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SECTION 02501

DISINFECTION OF WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Procedures for disinfecting new and repaired water distribution systems

B. Related Sections

1. Section 02502 – Testing of Water Distribution Systems

2. Section 02515 – Polyvinyl Chloride (PVC) Pipe and Fittings

3. Section 02518 – Valves and Hydrants

1.2 REFERENCES

A. American Water Works Association, AWWA C651, *AWWA Standard for Disinfecting Water Mains.*

B. American Public Health Association, American Water Works Association and Water Pollution Control Federation, *Standard Methods For the Examination of Water and Wastewater.*

1.3 SUBMITTALS

A. A formal statement in writing to the Engineer that all crews responsible for installation and repairs within the operating distribution system have been properly trained and are aware of prescribed construction practices and disinfection procedures to avoid contamination to the operating distribution system.

B. The name of competent person(s) responsible for the disinfection processes and performing the required bacteriological sampling. The Engineer will approve the disinfection process to be used in advance of any disinfection efforts.

C. Certificate of compliance that the independent commercial laboratory performing the bacteriological sampling analyses is certified with the State Department of Environmental Protection and U.S. Environmental Protection Agency for analyzing public drinking water supplies.

D. Certified results for all bacteriological sampling prior to restoring or placing the distribution system into service.

E. For each section of pipe to be chlorinated, the Contractor shall inform the Engineer in writing of the locations for taps to be installed and utilized for the procedure.

1.4 QUALITY ASSURANCE

A. Qualifications & Certifications

1. The Contractor shall employ trained personnel aware of the need to carefully observe prescribed construction practices and disinfection procedures in order to prevent contamination to the distribution system.

2. The competent person(s) responsible for the disinfection processes and bacteriological sampling shall be familiar with AWWA C651- Standards for Disinfecting Water Mains and experienced with the Continuous Feed Method of disinfection. The Engineer shall approve disinfection procedures in advance.

3. Bacteriological sampling shall be made in full accordance with AWWA C651 and under the supervision of the Engineer.

4. An independent commercial laboratory certified for analyzing public drinking water supplies by the State Department of Environmental Protection and U.S. Environmental Protection Agency shall analyze all bacteriological samples and provide certified results to the Engineer and/or Owner for review prior to restoring or placing the system into service.

1.5 PROJECT/SITE CONDITIONS

A. The general procedure for disinfection and analyses is described in Part 3, Execution, of this section. If project conditions warrant the need for special disinfection procedures, obtain prior written approval from the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. The forms of chlorine used in the disinfection operations shall conform to ANSI/AWWA B300. Materials Safety Data Sheets (MSDS) for the disinfectant shall be readily available for reference. The competent person responsible for the disinfection operation shall be fully trained and equipped to handle any emergency that may arise.

PART 3 EXECUTION

3.1 DISINFECTION

A. Before being placed into service, all new water pipelines shall be chlorinated using the Continuous Feed Method specified in AWWA C651 – Section 4.4.3. The Engineer shall approve the procedure in advance.

1. The Contractor will determine the location of the chlorination and sampling points in the field. The Contractor shall install taps for chlorinating, sampling and expulsion of air and shall uncover, backfill and plug the taps as required.

2. Prior to disinfecting the water main, the main shall be completely filled to remove all air pockets and then flushed to remove particulate. The flushing velocity in the main shall not be less than 2.5 ft/s unless the Engineer and/or Owner determine that the conditions do not permit the required flow to be discharged to waste.

TABLE 3.1-1
Required Flow to Flush Pipelines (40 psi residual pressure in water main)*

Pipe Diameter (in)	Flow Required to Produce 2.5 ft/s (Approximate) Velocity in Main	Number of 2 ½ inch Hydrant Outlets
4	100 gpm	1
6	200 gpm	1
8	400 gpm	1
10	600 gpm	1
12	900 gpm	2
16	1600 gpm	2

**AWWA C651, AWWA Standard for Disinfecting Water Mains*

3. At a point not more than 10 feet downstream from the beginning of the new main, water entering the new main shall receive a dose of chlorine fed at a constant rate such that the water will not have less than 25 mg/L (PPM) free chlorine throughout the entire section of pipe to be chlorinated.

TABLE 3.1-2
Chlorine Required to Produce 25-mg/L Concentration in 100 Feet of Pipe – By Diameter*

Pipe Diameter (in)	100 % Chlorine (Pounds)	1% Chlorine Solution (Gals.)
4	0.013	0.16
6	0.030	0.36
8	0.054	0.65
10	0.085	1.02
12	0.120	1.44
16	0.217	2.60

**AWWA C651, AWWA Standard for Disinfecting Water Mains*

4. The chlorinated water is to remain in the new pipeline for at least 24-hours. After a contact time of 24-hours there should be a free chlorine concentration of not less than 10 mg/L (PPM). During this period, proper precautions are to be taken to prevent this chlorinated water from flowing back into the existing system.

5. All valves and hydrants within the treated section shall be operated to ensure disinfection of the appurtenances.

B. The Tablet Method consisting of placing calcium hypochlorite granules or tablets in the water main as it is being installed and then filling the main with potable water and allowing it to set for a contact period is not acceptable.

C. The interior of all pipe, fittings and valves used in making a repair or tie-in shall be swabbed or sprayed with a one percent (1%) hypochlorite solution before they are installed.

3.2 FINAL FLUSHING

A. Following the chlorination period, all treated water shall be flushed from the lines at their extremities and replaced with water from the distribution system.

1. Flushing the main is to be accomplished at as high a velocity as possible consistent with the ability of the Contractor to collect the discharge water for proper disposal.

2. All treated water flushed from the lines shall be disposed of by discharging to the nearest sanitary sewer or by other approved means provided in AWWA C651.

3. Flushing shall be done in strict conformance with all applicable local, state and federal regulations. No discharge of chlorinated water to any storm sewer or natural watercourse will be allowed.

3.3 BACTERIOLOGICAL ANALYSES

A. After the 24-hour disinfection period and all chlorine solution has been thoroughly flushed, the bacteriological sampling and analysis of the replacement water may then be performed.

1. Bacteriological sampling shall be made by the Contractor's competent person(s) in full accordance with AWWA C651- Section 5*, Bacteriological Tests* and under the supervision of the Engineer.

2. Analysis shall be performed by an independent commercial laboratory certified by the State Department of Environmental Protection and U.S. Environmental Protection Agency for analyzing public drinking water supplies. All results shall be provided to the Engineer for review.

3. Two consecutive sets of acceptable samples, taken at least 24-Hours apart are required prior to placing the main into service. Failure of any one of the bacteriological test samples shall require rechlorination and retesting by the Contractor.

4. The line shall not be placed in service until the bacteriological requirements of AWWA C651 are met.

END OF SECTION

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SECTION 02502

TESTING OF WATER DISTRIBUTION SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Testing of pipe, castings, fittings, valves and accessories

1.2 REFERENCES

A. American Water Works Association, AWWA C605, Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe & Fittings for Water

B. ASTM B88, Standard Specification for Seamless Copper Water Tube

C. ASTM D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable

1.3 SUBMITTALS

A. List of equipment and personnel to be used for the pressure test.

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 TEST PARAMETERS

A. For water mains, the pressure test shall not be conducted until the new main has been flushed clean, disinfected in accordance with Section 02501 and the chlorinated water properly disposed of. After acceptable completion of the water system disinfection, the Contractor may commence pressure testing of the new water main.

B. Run pressure test and leakage test simultaneously in accordance with ANSI/AWWA C600.

C. Test pressure shall not be less than 1.25 times the working pressure at the highest point along the test section. Test pressure shall not exceed pipe or thrust-restraint design pressures.

D. The hydrostatic test shall be of at least 2-hour duration or until such time as the Engineer indicates acceptance of the pipeline.

E. Test pressure shall not vary by more than ±5 psi (35 MPa or 0.35 bar) for the duration of the test.

F. On pipelines where the elevation along the route of construction varies substantially, the Engineer reserves the right to valve off and test portions of the line.

G. On extensive construction jobs, the Engineer reserves the right to require the testing of individual portions of the line as construction proceeds rather than await completion of the entire project in order to undertake a pressure or leakage test.

H. Do not operate valves in either direction at differential pressure exceeding the rated valve working pressure. Use of a test pressure greater than the rated valve pressure can

result in trapped test pressure between the gates of a double-disc gate valve. For tests at these pressures, the test setup should include a provision, independent of the valve, to reduce the line pressure to the rated valve pressure on completion of the test. The valve can then be opened enough to equalize the trapped pressure with the line pressure, or fully opened if desired.

I. Test pressure shall not exceed the rated pressure of the valves when the pressure boundary of the test section includes closed, resilient-seated gate valves or butterfly valves.

3.2 TIME FOR MAKING TESTS

A. No pipeline is to be placed under pressure or subjected to hydrostatic pressure until at least 5 days have elapsed after the concrete thrust blocks have been installed. If high early strength concrete is used in the concrete thrust blocks, the hydrostatic pressure can be applied to the main after 2 days have elapsed from time of construction of the thrust blocks.

B. The Contractor will be allowed to complete backfilling as hereinbefore specified, prior to undertaking the leakage and pressure tests. Backfilling prior to conducting tests will be at the option of the Contractor with the exception of intersections, driveways, crosswalks and other such locations where holding open the trench may adversely affect the public.

C. Pipelines may be subjected to hydrostatic pressure and inspected for leakage at any convenient time after the trench has been partially backfilled. Partial backfilling shall consist of filling along the center of the pipe length and leaving the joint open for inspection.

3.3 OPERATION OF EXISTING WATER SYSTEM

A. Do not operate any valve or other control device on the existing water system for any purpose. Do not make any tap or cut-in to the existing water system without the approval of the Engineer and unless an authorized representative of the Owner is present.

B. When the Contractor's operations require the adjustment of any hydrant, valves, or other control device on the existing system, the Owner will provide authorized personnel for the purpose of supervising the operation of these control devices. Provide the personnel for the operation of these devices.

3.4 PREPARATION

A. Conduct connections to the existing system under the Engineer’s direction.

B. To allow for proper filling, venting, testing, etc., install any corporation stops and/or special fittings which may be required. All such installation will be subject to the Engineer’s approval.

C. Foreign materials left in pipelines during installation often results in valve or hydrant seat leakage during pressure tests. Thorough flushing is recommended prior to a pressure test by partially opening and closing valves and hydrants several times under expected line pressure, with flow velocities adequate to flush foreign material out of the main, valves and hydrants. Flushing requirements are specified in Specification 02501, Part 3.1.A.2.

3.5 PROCEDURE

A. On completion of the pipeline or any valved section thereof, fill pipeline with water and test. Draw water from the existing water system under the direction of the Engineer and the Water Department.

B. Before applying the specified test pressure, expel air completely from the pipe, valves, and hydrants. If permanent air vents are not located at all high points, install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, close the corporation cocks and apply the test pressure. At the conclusion of the pressure test, either remove and plug or leave in place the corporation cocks at the discretion of the Owner.

C. Slowly fill each valved section of pipe with water, and apply the specified test pressure as described in Part 3.1 by means of a pump connected to the pipe in a manner satisfactory to the Engineer. Valves shall not be operated in either the opening or closing direction at differential pressures above the rated pressure. The system shall be stabilized at the test pressure before conducting the leakage test.

3.6 EXAMINATION UNDER PRESSURE

A. Examine exposed pipes, fittings, valves, hydrants, and joints carefully during the test.

B. Repair or replace any cracked or defective pipe, fittings, valves, hydrants, or joints that are discovered following the pressure tests with sound material, and repeat the test until it is satisfactory to the Engineer.

3.7 LEAKAGE TEST

A. Leakage is defined as the quantity of water that must be supplied into the newly laid pipe, or any valved section thereof to maintain pressure after the pipe has been filled with water and the air has been expelled. Testing shall include all hydrants and hydrant branches. Leakage shall not be measured by a drop in pressure in a test section over a period of time.

B. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:

$$L = \frac{SD\sqrt{P}}{148{,}000}$$

Where: L = allowable leakage, in gallons per hour

S = length of pipe tested, in feet

D = nominal diameter of the pipe, in inches

P = average test pressure during the leakage test, in pounds per square inch (gauge)

This formula is based on an allowable leakage of 10.5 gpd/mi/in of nominal diameter at a pressure of 150 psi.

C. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gph/in. of nominal valve size will be allowed.

D. When hydrants are in the test section, the test shall be made against the closed main valve in the hydrant.

E. Acceptance of Installation - acceptance will be determined on the basis of allowable leakage. If any test of laid pipe discloses leakage greater than that specified in this section, locate and make approved repairs as necessary until the leakage is within the specified allowance at no additional cost to the Owner.

F. Visible leaks are to be repaired, regardless of the amount of leakage.

END OF SECTION

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SECTION 02503

TESTING OF SANITARY SEWER SYSTEMS AND STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Testing of Stormwater Drainage Systems

2. Testing of Gravity Sewer Systems

PART 2 PRODUCTS – NOT USED

PART 3 EXECUTION

3.1 TESTING OF STORM DRAINAGE SYSTEMS

A. Visually inspect all storm drainage structures included in the Work to ensure that all structures are clean of debris and sediment, and have frames, covers, grates, inverts, sumps, and other required appurtenances.

B. All flexible pipe types including polyvinyl chloride (PVC), high-density polyethylene (HDPE), or polypropylene (PP) shall be tested for deflection in accordance with Paragraph 3.2.D of this Section at least forty five (45) days after it has been backfilled.

3.2 TESTING OF GRAVITY SEWER SYSTEMS

A. Test all gravity sewers for allowable leakage by low pressure air test or by an infiltration/exfiltration water test as described herein.

B. No building shall be connected to a newly installed sewer until the sewer has been satisfactorily tested.

1. Low Pressure Air Test

a. After completing backfill of a section of pipe including laterals, conduct a line acceptance test using low-pressure air. Perform the test under the supervision of the Engineer.

b. Seal-test pneumatic plugs before use in the actual test installation. Lay one length of pipe on the ground and seal at both ends with the pneumatic plugs to be checked. Introduce air into the plugs to 25 psig. Pressurize the sealed pipe to 5 psig. Satisfactory pneumatic plugs will hold against this pressure without bracing and without movement of the plugs out of the pipe.

c. After a manhole reach of pipe has been backfilled and cleaned, and the pneumatic plugs have been checked, place a plug in each end of the line (at each manhole), and inflate the plugs to 25 psig. Introduce low pressure air into this sealed line until the internal air pressure reaches 4 psig greater than the average back pressure of any groundwater that may be over the pipe. Allow a minimum of two minutes for the air pressure to stabilize. After the stabilization period (3.5 psig minimum pressure in the pipe), disconnect the air hose from the control panel to the air supply. The

portion of the line being tested has passed the test 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 groundwater that may be over the pipe) is not less than the time shown for the given diameters and lengths in Table 1 at the end of this Section.

d. Air tests shall cover a 1.0 psig pressure drop; 0.5 psig pressure drop tests are not acceptable.

e. In areas where groundwater is known to exist, install a one-half inch diameter capped pipe nipple, approximately 10 inches long, through the manhole wall on top of one of the sewer lines entering the manhole. The nipple shall be installed at the time the sewer line is installed. Immediately prior to the line acceptance test, determine the elevation of the groundwater by removing the pipe cap, blowing air through the pipe nipple to remove any obstructions, and then connecting clear plastic tube to the nipple. Hold the hose vertically and measure the height after the water has stopped rising in this plastic tube. Divide the height in feet by 2.3 to establish the pressure in pounds per square inch (psig) that will be added to all readings. (For example, if the height of water is 11.5 feet, then the added pressure will be 5 psig. This increases the 3.5 psig to 8.5 psig, and the 2.5 psig to 7.5 psig. The allowable drop of one pound per square inch and the timing remain the same.)

f. The maximum starting test pressure should not exceed 9 psig, regardless of groundwater level above the pipe. If the groundwater level is such that the added pressure would be greater than 5.5 psig (12.7 feet), the pipe section may be tested using a starting pressure of 9 psig.

g. Each pipe nipple installed to measure groundwater levels should be recapped subsequent to the air testing procedure to prevent future infiltration.

h. As an alternative to installing a pipe nipple in a manhole to measure the height of groundwater, excavate a test pit over the pipe to determine the height of groundwater.

2. Infiltration/Exfiltration Test

a. Where new sewers are installed in areas having a high groundwater level, conduct an infiltration test for a minimum of four hours under the supervision of the Engineer. Isolate various sections of the sewer using of watertight plugs, and measure the quantity of water entering the pipe during a predetermined time. If the conditions are such that groundwater table varies depending on surrounding influence and time of the year, or if the table elevation is unknown at the time of testing, excavate test holes as directed by the Engineer.

b. Where lines are installed in relatively dry areas, conduct an exfiltration test. Isolate various sections of the line using watertight plugs, and fill the line with water to a predetermined level. Determine the loss of water in a predetermined time by measuring the quantity of water required to refill the line to the original level.

c. The Engineer will determine the length of new sewer to be tested at one time, depending on the grade of the sewer.

d. Include losses through manholes in determining the loss in a sewer line. For an exfiltration test, fill manholes to the bottom of the cone or flat top section and allow the level to stabilize before beginning the test. Refilling to the reference line may be required before commencing the test.

e. The maximum acceptable loss, through either infiltration or exfiltration, shall not exceed 100 gallons per mile per 24 hours per inch of diameter of the pipe tested. When two or more pipeline sections are tested at the same time, the allowable leakage for the shortest section shall be used as the acceptable loss for the entire length being tested.

C. Vacuum Test for Manholes - Gravity Sewer Lines

1. After a manhole has been constructed, conduct a manhole acceptance test using the following vacuum test procedure:

a. Plug all lift holes with an approved non-shrink grout.

b. Plug all pipes entering the manhole, taking care to securely brace the plug from being drawn into the manhole.

c. Place the test head at the inside of the top of the precast concrete cone section and inflate the seal in accordance with the manufacturers' recommendations.

d. Draw a vacuum of 10 inches of mercury and shut off the vacuum pump. With the valves closed, measure the time for the vacuum to drop to 9 inches. The manhole shall pass if the time is greater than:

1 min. 0 sec. for 0-ft. to 10-ft. deep manholes

1 min. 15 sec. for 10-ft. to 15-ft. deep manholes

1 min. 30 sec. for 15-ft. to 25-ft. deep manholes

e. If the manhole fails the initial test, make repairs with a non-shrink grout. Re-test until a satisfactory test is obtained.

D. Allowable Deflection Test for flexible pipe types including polyvinyl chloride (PVC), high-density polyethylene (HDPE), or polypropylene (PP)

1. Pipe deflection measured not less than 45 days after the backfill has been completed shall not exceed 5 percent. Deflection shall be computed by multiplying the amount of deflection (average outside diameter less twice the average wall thickness diameter when measured) by 100 and dividing by the nominal diameter of the pipe.

2. Deflection shall be measured with a rigid mandrel (Go-No-Go) device cylindrical in shape and constructed with a minimum of nine or ten evenly spaced arms or prongs. Submit drawings of the mandrel with complete dimensions for each diameter of pipe to be tested. Hand-pull the mandrel through all sewer and drain lines.

3. Uncover any section of pipe not passing the mandrel and replace the bedding and backfill to prevent excessive deflection. Replace sections of the pipe as necessary. Retest repaired pipe immediately upon backfilling of trench until acceptable.

4. Retest the repaired section of pipeline again, from manhole to manhole, after the 45-day backfill period, until acceptable.

E. Test Failures

1. In case leakage or deflection exceeds the above specified amount, locate the failure and repair it in accordance with applicable Sections of this Contract.

2. Pipelines with shear-type breaks, "fishmouths" or damaged gaskets, cracked bells or couplings, hairline fractures, or structural damage shall be replaced. Mechanical sleeve couplings, poured concrete collars or similar repairs are not permitted. The use of pressure grouting repair techniques will not be allowed without the written consent of the Engineer.

3. After repairs have been made, re-test the line and repeat the process of repairing and re-testing until satisfactory test results, as specified in this Section, are obtained.

F. Alignment of Gravity Sewers and Drains

1. Lay gravity sewers and drains accurately to line and grade.

2. After the pipe is laid and backfill complete, TV inspect the interior of the pipe from manhole to manhole. If excessive deviation in either the horizontal or vertical alignment is observed by the Engineer, the alignment is considered unacceptable.

3. If the alignment is unacceptable due to horizontal displacement, the Contractor will be allowed to construct intermediate manholes at his own expense. If the alignment is unacceptable due to vertical displacement, remove and replace the pipe to the proper grade.

END OF SECTION

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TABLE 1
Low Pressure Air Test
Specification Time Required for a 1.0 PSIG Pressure Drop
For Size and Length of Pipe Indicated for Q=0.0015 Cubic Feet per Minute per Square Foot of Internal Surface

1	2	3	4	Specification Time for Length (L) Shown (min:sec)							
Pipe Diameter (in.)	**Minimum Time (min:sec)**	**Length for Minimum Time (ft)**	**Time for Longer Length (sec)**	**100 ft.**	**150 ft.**	**200 ft.**	**250 ft.**	**300 ft.**	**350 ft.**	**400 ft.**	**450 ft.**
4	3:46	597	.380 L	3:46	3:46	3:46	3:46	3:46	3:46	3:46	3:46
6	5:40	398	.854 L	5:40	5:40	5:40	5:40	5:40	5:40	5:42	6:24
8	7:34	298	1.520 L	7:34	7:34	7:34	7:34	7:36	8:52	10:08	11:24
10	9:26	239	2.374 L	9:26	9:26	9:26	9:53	11:52	13:51	15:49	17:48
12	11:20	199	3.418 L	11:20	11:20	11:24	14:15	17:05	19:56	22:47	25:38
15	14:10	159	5.342 L	14:10	14:10	17:48	22:15	26:42	31:09	35:36	40:04
18	17:00	133	7.692 L	17:00	19:13	25:38	32:03	38:27	44:52	51:16	57:41
21	19:50	114	10.470 L	19:50	26:10	34:54	43:37	52:21	61:00	69:48	78:31
24	22:40	99	13.674 L	22:47	34:11	45:34	56:58	68:22	79:46	91:10	102:33
27	25:30	88	17.306 L	28:51	43:16	57:41	72:07	86:32	100:57	115:22	129:48
30	28:20	80	21.366 L	35:37	53:25	71:13	89:02	106:50	124:38	142:26	160:15
33	31:10	72	25.852 L	43:05	64:38	86:10	107:43	129:16	150:43	172:21	193:53
36	34:00	66	30.768 L	51:17	76:55	102:34	128:12	153:50	179:29	205:07	230:46

Uni Bell PVC Pipe
Association Publication
Uni-B-6-90

SECTION 02515

POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. PVC Gravity Pipe and Fittings

2. Perforated PVC Drain Pipe

B. Related Sections

1. Section 02315 - Excavation, Backfill, Compaction, and Dewatering

2. Section 02320 - Borrow Material

3. Section 02503 - Testing of Sanitary Sewer and Storm Drainage Systems

1.2 REFERENCES

A. ASTM D2412 - Standard Test Method for External Loading Properties of Plastic Pipe by Parallel-Plate Loading

B. ASTM D2444 - Standard Test Method for Impact Resistance of Thermoplastic Pipe and Fittings by Means of a Tup (Falling Weight)

C. ASTM D3034 - Specification for Type PSM Polyvinyl Chloride (PVC) Sewer Pipe and Fittings

D. ASTM D3139 - Standard Specifications for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

E. ASTM D3212 - Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

F. ASTM F477 - Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe

G. ASTM F679 - Specification for Polyvinyl Chloride (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings

H. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., For Water Distribution

1.3 SUBMITTALS

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

B. Prior to first shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the ASTM Standards specified herein.

1.4 QUALITY ASSURANCE

A. Each type of PVC pipe and fittings shall be from a single manufacturer. Alternatively, the pipe manufacturer shall provide certification that the fittings are suitable for installation with the pipe.

B. Inspection of the pipe will also be made by the Owner after delivery. The pipe shall be subject to rejection at any time on account of failure to meet any of the Specification requirements. Pipe rejected after delivery shall be marked for identification and shall immediately be removed from the job site.

1.5 SPARE PARTS

A. Supply 4 tee handle wrench operators suitable to operate the curb stops installed under this section.

PART 2 PRODUCTS

2.1 MATERIALS

A. Gravity Pipe

1. Polyvinyl chloride (PVC) pipe shall be of the size indicated on the Drawings or as specified and shall conform to the latest revision of ASTM D3034, Type SDR 35 for diameters less than or equal to 15 inch diameter and ASTM F679 for pipe greater than 15 inch diameter. Standard laying lengths shall not exceed 14.0 feet.

2. Joints shall be elastomeric gasket joints and shall provide a watertight seal. Gaskets shall be in accordance with ASTM F477. Assembly of joints shall be in accordance with ASTM D3212.

3. The minimum "pipe stiffness" (load divided by change in inside diameter in direction of load application) at 5% deflection shall be at least 46 psi for pipe tested in accordance with ASTM D2412.

4. No shattering or splitting shall be evident when 150 ft.-lbs. and 210 ft.-lbs. is impacted on 4 inch and 6 inch diameter pipe, respectively, in accordance with ASTM Method of Test D2444.

5. Pipe lengths and fittings to be used on the project shall be clearly marked on the outside in bold type with the name of the manufacturer, pipe size, pipe material, pipe class, and ASTM designation.

6. Gravity Pipe Connections

a. Gravity pipe connection wyes and tees are to be laid in the run of the main pipeline. The wyes and tees shall be the same material as the main line and shall conform in material, joints and class with the line into which they are to be laid.

b. Eighth and sixteenth bends and end plugs are to be of the same material and class or strength designation as the pipe for the house connection.

c. Unless noted on the Drawings, house service piping shall be 6 inch diameter and shall be of the same material as the main line PVC pipe.

7. Lateral Service Chimneys

a. Pipe and fittings shall be 6 inch diameter and be of the same material as the main line PVC pipe.

B. Perforated Pipe

1. Perforated polyvinyl chloride pipe shall be Type PS-46 PVC and conform to ASTM F758. Perforated pipe shall be furnished in lengths of not more than 20 feet.

2. Alternately, perforated polyvinyl chloride pipe hall conform to ASTM D3034 in sizes 4 through 15 inch. Perforations shall be two rows of ½ inch diameter holes spread longitudinally, 6 inch (maximum) apart and shall be oriented 120 degrees apart (60 degrees either side of the pipe bottom). A maximum tolerance of ¼-inch on hole spacing and size will be allowed. The top of pipe shall be marked for ease of installation.

PART 3 EXECUTION

3.1 HANDLING PIPE AND FITTINGS

A. Take care in loading, transporting, and unloading to prevent injury to the pipe. Do not drop pipe or fittings. Examine pipe and fittings before installing, and no piece shall be installed that is found to be defective.

B. If any defective pipe is discovered after it has been installed, remove and replace it with a sound pipe in a satisfactory manner. Thoroughly clean pipe and fittings before installing, keep clean until they are used in the work, and conform to the lines, grades and dimensions required when installed.

C. Pipe ends requiring cutting shall be cut square without damage to the remaining pipe. Bevel cut pipe ends 1/8 inch at approximately 30 degrees to provide proper assembly of the joint. Beveling can be done with a coarse file or portable grinder.

D. Support stored pipe from below at not more than 3 foot intervals to prevent deformation. Do not stack pipe higher than 6 feet. Store pipe and fittings in a manner which will keep them at ambient outdoor temperatures. Provide temporary shading as required to meet this requirement. Simply covering of the pipe and fittings which allows temperature buildup when exposed to direct sunlight will not be permitted.

3.2 INSTALLATION

A. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length. If a piece of pipe fails to meet this required check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

B. Install piping and fittings true to alignment and grade. If necessary, each length of pipe shall be cleaned out before installation.

C. Excavation, trenching and back filling procedures shall be in accordance with Section 02315.

D. All PVC gravity pipe shall be installed on a bed of 3/4-inch crushed stone borrow meeting the requirements of Section 02320 and have a minimum depth of 6 inches. The 3/4-inch crushed stone borrow shall also completely encase the pipe and cover the pipe to a grade 6 inches over the top of the pipe for the entire width of the trench. Bell holes shall be made in the 3/4-inch crushed stone borrow bedding such that the pipe shall be uniformly supported throughout the entire length of the barrel section.

E. All pipe shall be tested in accordance with Section 02503.

F. All PVC force main pipe shall be installed with proper bedding using compacted native materials which provide uniform longitudinal support under the pipe. When an unstable subgrade material is encountered which will provide inadequate pipe support, additional trench depth should be excavated and refilled with suitable material. Initial backfill material should be placed to a minimum one foot over the top of the pipe. Pipe backfill material should be selected and placed carefully, avoiding stones, frozen lumps, and debris.

G. All force mains shall be water tested in accordance with Section 02503.

H. Deflections in Pipe Alignment

1. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long-radius curves are permitted, the amount of deflection allowed shall not exceed that required for satisfactory making of the joint, and shall be approved by the Engineer.

2. Prior to deflecting the pipeline, the spigot of the pipeline should be marked flush with the bell end to assure that the spigot is not withdrawn excessively as the result of the deflection. After the pipe is deflected, an adequate depth of jointing material must remain on the side where the spigot is away from home and an adequate width of caulking space must remain on the opposite side of the pipe at the face of the bell.

3. The maximum deflection recommended by the manufacturer when using any pipe system must be observed when deflecting a pipeline.

4. In general, all radius curves called for on the Drawings or permitted at the time of construction are to be made using full lengths of pipe. The use of short lengths of pipe and extra joints in order to make a smaller radius turn will not be allowed without the written approval of Engineer.

I. Unsuitable Laying Conditions

1. No pipe shall be laid in water, in an unsuitable trench or during unsuitable weather conditions.

END OF SECTION

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SECTION 02516

HIGH DENSITY POLYETHYLENE PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. High density polyethylene (HDPE) pipe for:

a. Storm drainage lines

2. Types of HDPE piping specified in this Section include:

a. Corrugated exterior, smooth interior, solid wall HDPE pipe

B. Related Sections

1. Section 02315 – Excavation, Backfill, Compaction and Dewatering

2. Section 02320 – Borrow Materials

3. Section 02503 – Testing of Sanitary Sewer and Storm Drainage Systems

1.2 REFERENCES

A. AASHTO M252 –Corrugated Polyethylene Drainage Pipe

B. AASHTO M294 – Corrugated Polyethylene Pipe, 300- to 1200-mm Diameter

C. AASHTO MP7 – Corrugated Polyethylene Pipe, 1300- to 1500-mm Diameter

D. ASTM D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials For Wire and Cable

E. ASTM D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

F. ASTM D2321 – Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

G. ASTM D2412 – Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading

H. ASTM D2683 – Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

I. ASTM D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing

J. ASTM D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials

K. ASTM D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

L. ASTM D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

M. ASTM D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials

N. ASTM F405 – Standard Specification for Corrugated Polyethylene (PE) Tubing and Fittings

O. ASTM F667 – Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings

P. ASTM F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.

Q. ASTM F894 – Standard Specification for Polyethylene (PE) Large-Diameter Profile Wall Sewer and Drain Pipe

R. ASTM F905 – Standard Practice for Qualification of Saddle Fusion Joints

S. ASTM F2620 - Standard Practice of Heat Fusion Joining of Polyethylene Pipe and Fittings

1.3 SUBMITTALS

A. Submit product data on the pipe, fittings, and accessories.

B. Prior to first shipment of pipe, submit certified test reports that the pipe for this Contract was manufactured and tested in accordance with the appropriate ASTM standards specified herein.

C. Submit one 12-inch long sample of each diameter of HDPE pipe proposed for use in the HDD operation.

D. Submit resumes for all personnel performing heat fusion joining.

1.4 QUALITY ASSURANCE

A. Personnel performing heat fusion joining shall have adequate training and experience in the procedure, demonstrated by at least twelve months applicable experience.

B. Use an adequate number of skilled laborers, equipment of adequate size, capacity, and quantity to perform the work of this Section, and its related Sections, in a timely manner.

C. Materials to be used in conjunction with potable water systems shall conform to NSF/ANSI 61 (Drinking Water System Components).

1.5 DELIVERY, STORAGE AND HANDLING

A. When lifting with slings, only wide fabric choker slings capable of safely carrying the load shall be used. Wire rope or chain shall not be used to handle pipe.

PART 2 PRODUCTS

2.1 MANUFACTURER – GENERAL

A. The manufacturer shall have manufacturing and quality assurance facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications.

B. Pipe and fittings from different manufacturers shall not be interchanged for the same type of pipe and application.

2.2 PIPE IDENTIFICATION

A. The following shall be continuously indent printed on the pipe or spaced at intervals not exceeding five-feet:

1. Name and/or trademark of the pipe manufacturer.

2. Nominal pipe size.

3. Dimension ratio.

4. The letters “PE” followed by the polyethylene grade in accordance with the ASTM designation, followed by the hydrostatic design basis in PSI.

5. A production code from which the date and place of manufacture can be determined.

2.3 CORRUGATED EXTERIOR/SMOOTH INTERIOR HDPE PIPE AND FITTINGS

A. General

1. The polyethylene pipe and fittings shall comply with AASHTO M294, Type S (smooth wall interior).

2. Piping shall be manufactured by Advanced Drainage Systems, Inc., or equal.

3. Pipe material and fittings shall be high density polyethylene meeting ASTM D3350 minimum cell classification 324420C (4”-10”) or 325420C (12”-60”).

4. Installation shall be in accordance with ASTM D2321.

5. Pipe shall be joined with the bell-and-spigot joint. Gaskets and joint lubricant shall be utilized.

6. Minimum parallel plate pipe stiffness shall be as recommended for each specified diameter pipe per ASTM Test Method D2412.

7. The pipe and fittings shall be free of foreign inclusions and visible defects. The ends of the pipe shall be cut squarely and cleanly so as not to adversely effect joining.

8. The nominal size of the pipe and fittings is based on the nominal inside diameter of the pipe. Corrugated fittings may be either molded or fabricated by the manufacturer. Fittings and gaskets supplied by manufacturers other than the supplier of the pipe shall not be permitted without the approval of the Engineer.

2.4 JOINTS FOR CORRUGATED PIPING

A. General

1. Joints of corrugated pipe sections and fittings other than smooth interior, shall be made with split couplings, corrugated to engage the pipe corrugations, and shall engage a minimum of 4 corrugations, 2 on each side of the pipe joint. Where required by the Engineer, a neoprene gasket shall be utilized with the coupling to provide a soil tight joint.

2. Joints of smooth interior, corrugated pipe sections shall be as per manufacturer's instructions utilizing gasketed PVC or HDPE joints meeting ASTM D-3212.

3. Installation shall be in accordance with ASTM Recommended Practice D-2321 or as specified by the Engineer or local approving agency.

B. Leak Resistant/Silt-Tight Pipe

1. Pipe shall provide soil-tight joints with built-in gaskets. Bee joints shall be same as the outside diameter of the pipe.

2. Shall be ADS, N-12 IB ST (soil-tight joint type) piping, or equal.

3. Meets silt-tight & leak resistant (not defined as watertight) joint requirements.

4. For non-watertight connections, exterior HDPE culvert coupling may be used with dedicated ties.

5. Polyethylene flared end sections shall be manufactured to the same criteria as mainline pipe sections.

6. Non-Watertight Manhole Connections - To be made with non-shrink grout.

C. Watertight Pipe

1. Provides superior watertight performance.

2. Meets ASTM D3212 requirements of 10.8 PSI for 10 minutes with no leakage.

3. Shall be ADS, N-12 IB WT (watertight joint type) piping, or equal.

D. Manhole Boot Connection

1. Watertight seal made with rubber manhole boot as manufactured by Press Seal, or equal.

2. Alternatively, watertight seal made by Alok, or equal, in which case maximum insertion angle is 7 degrees.

E. Watertight Seals for Corrugated HDPE Pipe - Shall be NPC Corrugated Pipe Adapter compatible with Kor-N-Seal manhole connector.

PART 3 EXECUTION

3.1 PREPARATION

A. The Contractor shall verify that the surface has been prepared to the proper line and grade by shooting invert elevation grades.

3.2 INSTALLATION

A. Open-Cut Installations

1. Polyethylene pipe and fittings shall be installed in accordance with ASTM Standards, and the manufacturer’s recommendations.

2. Pipe is to be lifted or rolled into position, not dragged over the prepared bedding.

3. The pipe is to be set at the slope and grades indicated on the plans. Ensure pipe remains at proper grades by shoring it.

4. All HDPE piping shall be bedded in 6” of crushed stone unless noted otherwise.

5. Crushed stone shall be used as backfill to a point of 6" above the top of the pipe unless noted otherwise.

6. Clay dams shall be installed in the stone backfill as directed by the Engineer to prevent groundwater migration. Spacing shall be 50 ft. maximum. Clay borrow shall be in accordance with Section 02320 requirements for low permeability borrow.

7. Open-Trench Installations - Prepare the area in accordance with Section 02315 – Excavation, Backfill and Compaction.

8. No single piece of pipe shall be laid unless it is generally straight. The centerline of the pipe shall not deviate from a straight line drawn between the centers of the openings at the ends of the pipe by more than 1/16 inch per foot of length. If a piece of pipe fails to meet this requirement check for straightness, it shall be rejected and removed from the site. Laying instructions of the manufacturer shall be explicitly followed.

9. Install piping and fittings true to alignment and grade. If necessary, each length of pipe shall be cleaned out before installation.

B. Joint Couplings

1. Joint couplings shall be installed in accordance with manufacturer's recommendations.

2. Remove the protective paper and wrap the collar around the pipe with the mastic side to the pipe. The overlap shall be at the top of the pipe.

3. Secure the steel straps.

4. The closing flap shall cover the exposed straps.

5. Encase the entire joint with a minimum of 8 inches of concrete on all sides. The concrete encasement shall extend along the pipe 12 inches on each side of the joint.

3.3 TESTING

A. Pressure Testing

1. All sections of polyethylene drain and sewer pipe shall be tested in accordance with Section 02503.

END OF SECTION

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SECTION 02518

VALVES AND HYDRANTS

PART 1 GENERAL

1.1 SUMMARY

A. This Section is for buried valves.

B. Section Includes

1. Types of valves specified herein include:

a. Gate Valves

b. Valve Boxes

c. Yard Hydrants

C. Related Sections

1. Section 02315 - Excavation, Backfill, Compaction and Dewatering

2. Section 02502 – Testing of Water Distribution Systems

3. Section 02503 – Testing of Sanitary Sewer and Storm Drainage Systems

1.2 REFERENCES

A. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings

B. ASTM A276 – Standard Specification for Stainless Steel Bars and Shapes

C. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength

D. ASTM A563 – Standard Specification for Carbon and Alloy Steel Nuts

E. ASTM A564 – Standard Specification for Hot-Rolled and Cold-Finished Age-Hardening Stainless Steel Bars and Shapes

F. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

G. ASTM B584 – Standard Specification for Copper Alloy Sand Castings for General Applications

H. ASTM D429 – Standard Test Methods for Rubber Property Adhesion to Rigid Substrates

I. ASTM D1784 – Standard Specification for Rigid Polyvinyl Chloride (PVC) Compounds and Chlorinated Polyvinyl Chloride (CPVC) Compounds

J. ASTM D4101 – Standard Specification for Polypropylene Injection and Extrusion Materials

K. AWWA C207 – Steel Pipe Flanges for Waterworks Service – Sizes 4 Inch Through 144 Inch (100 mm Through 3,600 mm)

L. AWWA C500 – Metal-Seated Gate Valves for Water Supply Service

M. AWWA C504 - Rubber-Seated Butterfly Valves

N. AWWA C508 - Swing-Check Valves for Waterworks Service, 2 in. (50 mm) through 24 in. (600 mm) NPS

O. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service

P. MSS SP45 - Bypass and Drain Connections

Q. MSS SP80 - Bronze Gate, Globe, Angle and Check Valves

R. NSF/ANSI Standard 61 and NSF/ANSI Standard 372 – Drinking Water System Components

1.3 SYSTEM DESCRIPTION

A. Furnish all labor, materials, equipment, and incidentals required to install, complete and ready for operation, all valves, hydrant assemblies, and appurtenances as shown on the Contract Drawings and as specified herein.

1.4 SUBMITTALS

A. Submit complete Shop Drawings of all valves, valve boxes, and other material specified in this Section including but not limited to the following:

1. Product data including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.

B. Submit certifications regarding all iron or steel products that all manufacturing processes occurred in the US.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Ensure valves are dry and internally protected against rust and corrosion.

2. Protect valve ends against damage to threads, flange faces, and weld-end preps.

3. Set valves in best position for handling:

B. Use the following precautions during storage:

1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.

2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.

C. Use a sling to handle valves whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 PRODUCTS

2.1 AMERICAN IRON AND STEEL

A. All iron and steel products included in this section shall be manufactured in the US.

2.2 GENERAL

A. Valves, and appurtenances shall conform to the standards of the Barnstable Water Supply District.

B. Pressure and temperature ratings shall be as scheduled.

C. Valve sizes shall be the same size as the upstream pipe, unless otherwise indicated.

D. Provide accessories including bolts, nuts, glands, and gaskets.

E. Extended Stems - Where insulation is indicated or specified, provide extended stems arranged to receive insulation.

F. Valves shall have the same end connections as the pipeline in which it is installed.

G. Valves and appurtenances shall be of the size shown on the Contract Drawings.

H. Equipment of the same type shall be from one manufacturer, unless otherwise approved.

I. Valves, and appurtenances shall have the name of the manufacturer, flow directional arrows, and the working pressure for which they are designed cast in raised letter upon some appropriate part of the body.

J. Valves for water distribution systems shall be certified to NSF 61.

K. Bolts shall be 304 stainless steel with hex heads and hex nuts in accordance with ASTM A-307 and A-563, respectively.

L. Provide buried valves with standard valve box with tee-handle operator.

M. Valves installed inside buried structures shall be hand-wheel or lever operated.

2.3 GATE VALVES (RESILIENT SEAT)

A. Gate valves shall be resilient seat type complying with the requirements of AWWA C509. C509 gate valves shall be cast iron or ductile iron.

B. Gate valves shall be designed to be bubble tight for 250 psig water working pressure with no leakage past the seat from either side of the disc, and shall be hydrostatically tested to 500 psig.

C. Gate valves shall be of the non-rising stem (N.R.S.) design.

D. Gate valves shall be set vertically (spur gearing).

E. Gate valves shall open right (clockwise).

F. Buried gate valves shall be furnished with 2 inch square operating nuts.

G. Cast iron shall meet the specifications of ASTM A126, Class B. Castings shall be clean and sound without defects that will impair their service. No plugging or welding of such defects will be allowed. Ductile iron shall meet the standards of ASTM A536.

H. The resilient-seated disc wedge shall be of the resilient wedge fully supported type, either cast iron or ductile iron. Solid guide lugs shall travel within channels in the body of the valve. The disc and guide lugs shall be fully encapsulated in SBR (styrene butadiene rubber) or EPDM rubber. Disc wedges that are not 100% fully encapsulated shall not be acceptable. Provide guide caps of an acetal copolymer bearing material to

protect the rubber-encapsulated solid guide lugs from abrasion for long life and ease of operation.

I. The seat shall be SBR or EPDM rubber, matching the disc encasement. The seating surface (rubber) shall be specially designed so as to provide a smooth waterway, without depressions or cavities, which might trap debris and interfere with tight closures.

J. The body, bonnet, and gate shall be cast/ductile iron, constructed in accordance with AWWA C509. The bonnet to body seal shall incorporate a flat neoprene gasket. Bonnet and body flanges shall be fully machined to assure proper sealing of the gasket.

K. Gate valve stems shall be of bronze rolled bar stock in accordance with ASTM B584, and shall have a forged thrust collar. The thrust collar shall be factory lubricated, and the thrust collar and its lubrication shall be isolated by the O-Rings from the water way and from outside contamination, providing permanent lubrication for long term ease of operation. An anti-friction thrust washer shall be provided both above and below the thrust collar for ease of operation.

L. Gate valves shall have O-Ring sealed stems with one O-Ring located below the thrust collar and two O-Rings located above the thrust collar. The two O-Rings located above the thrust collar shall be replaceable with the valve still in service in the fully open position.

M. Coat internal and external exposed ferrous surfaces of the valve with a fusion-bonded, thermosetting powder epoxy coating suitable for potable water service conforming to AWWA C550. Coating shall be non-toxic and shall impart no taste to water. Coating thickness shall be nominal 10 mils. Gate valves for water distribution systems shall be certified to NSF 61.

N. Gate valves shall be as manufactured by U.S. Pipe Metroseal (Model 250), Mueller (Model 2360), American Flow Control (AFC-2500), Clow (2630 Series), equivalent by M&H Valve Company, or equal

O. Gate valves 3-inch and smaller shall have body and bonnet of ASTM B62 cast bronze with threaded or soldered ends, solid disc, copper-silicon alloy stem,. Brass backing gland, “Teflon” impregnated packing, and malleable iron handwheel.

2.4 MANUAL OPERATORS

A. Provide lever handles for quarter-turn valves 4 inches and smaller. Provide one lever handle for each valve supplied.

B. Equip valves 6 inches and larger with gear actuators capable of withstanding an overload input torque of 450 ft/lbs at full open or closed positions without change to the valve or valve operation. All gearing shall be enclosed with seals provided on all shafts to prevent entry of dirt and water into the actuator. All shaft bearings shall be furnished with permanently lubricated bronze bearing bushings. Actuator housing shall be cast iron (ASTM A126 Class B).

C. Manual actuator hand wheels shall be furnished on valves 6 inches and larger. Valves shall be mounted vertically with right angle drive actuators. All components of the actuators shall be designed to withstand, without damage, a pull of 200 pounds as required by AWWA C504 - Section 12.3. Actuators shall be designed to close with an effort of less than 40 pounds torque.

2.5 VALVE BOXES (FOR BURIED VALVES)

A. Provide a valve box of the adjustable type of heavy pattern, constructed of cast iron and provided with a 6 inch cast iron cover for each buried valve.

B. Valve boxes shall be manufactured in North America by Clow Corporation, Tyler/Union Corporation, United States Foundries, or equal.

C. Valve boxes shall be round, 2-piece, sliding type, cast iron. The upper section of each box shall have a flange on top having sufficient bearing area to prevent settling. The bottom of the lower section shall be belled to enclose the operating nut of the valve. The barrel shall be 5-1/2 inch O.D. minimum.

D. Boxes shall be of lengths consistent with pipe depths. Boxes shall be adjustable, with a lap of at least 6 inches when in the most extended position.

E. Slot covers for easy removal.

F. Covers for valve boxes shall have the word "WATER" cast in the top.

G. Coat valve boxes with coal-tar pitch enamel or other approved coating.

H. Valve boxes shall be suitable for the size valve on which they are used. The length of the lower section shall be adequate for trench adjustment, no top or mid-section adapters.

I. Provide one tee-handled wrench for every four valves installed, unless additional wrenches are required due to variations in valve bury depth. Wrenches shall be field measured to accommodate the depth of bury and provide waist high operation.

2.6 YARD HYDRANTS

A. General

1. Install hydrants with a precast thrust block behind it surrounded with gravel. Provide a pocket of crushed stone (minimum 5 cubic feet) around the base of the hydrant.

2. Furnish any and all adapters, unions, tees, and reducers, required for each hydrant connection.

3. Smear all threaded portions of joints with mastic.

4. Provide 18 inch by 18 inch by 3 inch concrete splash pads at each yard hydrant outlet location.

B. Low-Capacity Units

1. Low capacity yard hydrants shall be 2 inch compression type, non-freezing hydrants fitted with 1½ inch I.P.S. bottom inlet, ¾ inch hose connection, 5½ foot bury depth, lever-operated.

2. Provide tapped bleed fitting(s), 1/8 inch minimum diameter, at base of yard hydrant to stone pocket.

3. Provide vacuum breaker for use with hose assembly.

4. Yard hydrant shall be automatic draining, freezeless, lockable, completed sealed with a maximum operating pressure of 150 psi.

5. Acceptable manufacturers are Simmons, Mifab, Boshart Industries, Woodford, Murdock, or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks used to prevent disc movement during shipping and handling.

B. Actuate valve through an open-close and close-open cycle. Examine functionally significant features, such as guides and seats made accessible by such actuation. Following examination, return the valve closure member to the shipping position.

C. Examine threads on both the valve and the mating pipe for form (i.e., out-or-round or local identification) and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.

E. Prior to valve installation, examine the piping for cleanliness, freedom from foreign materials, and proper alignment.

F. Replace defective valves with new valves.

3.2 VALVE INSTALLATION

A. Refer to the Drawings and piping system specification Sections for specific valve applications and arrangements.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.

D. Install valves in horizontal piping with stem at or above the center of the pipe.

E. Install valves in a position to allow full stem movement.

F. Install valves and actuators to be plumb in the vertical direction.

G. Threaded Connections

1. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

2. Align threads at point of assembly.

3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).

4. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

H. Flanged Connections

1. Align flange surfaces parallel.

2. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.

3.3 HYDRANT INSTALLATION

A. Excavation, trenching and back filling procedures shall be in accordance with Section 02315.

B. Provide thrust blocks for all hydrants with bearing against the foot or bottom of the hydrant and against the vertical face of undisturbed soil behind the hydrant. The bearing areas of the thrust block on the soil shall be as shown on the Drawings.

C. Provide one cubic yard of washed ¾ inch stone around hydrant drains.

D. All newly installed hydrant and branch connections shall be subject to line pressure in an open trench to determine tightness of joints before backfilling, unless they are part of the overall pipeline pressure and leakage testing.

3.4 INSPECTION AND TESTING

A. Valves shall be inspected and tested in conjunction with the pipelines in which they are installed in accordance with Section 02502.

3.5 FIELD QUALITY CONTROL

A. After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.6 CLEANING

A. Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.

3.7 FINAL ACCEPTANCE AND WARRANTY

A. Final acceptance of all equipment furnished under these Specifications will be withheld until after the installation and field testing by the Engineer. The manufacturer and the Contractor shall guarantee the equipment against defects of any kind for a period of one year after final testing and acceptance.

END OF SECTION

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SECTION 02519

WATER SERVICES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Furnish all labor, materials, equipment, and incidentals required to:

a. Tap the existing water main to provide new water services

2. Materials provided under this section include:

a. Corporations

b. Curb Stops and Boxes

c. Unions, Couplings, and Connection Adapters

d. Service Saddles

e. Polyethylene Tubing

f. Tracer Wire

B. Related Sections

1. Section 02315 – Excavation, Backfill, Compaction and Dewatering

2. Section 02320 – Borrow Materials

3. Section 02501 – Disinfection of Water Distribution Systems

4. Section 02502 – Testing of Water Distribution Systems

5. Section 02518 – Valves and Hydrants

1.2 REFERENCES

A. AWWA C651 – Disinfecting Water Mains

B. AWWA C800 – Underground Service Line Valves and Fittings.

C. AWWA C901 – Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) Through 3 In. (76 mm), for Water Service

D. ASTM A48/A48M – Standard Specification for Gray Iron Castings.

E. ASTM A536 – Standard Specification for Ductile Iron Castings.

F. ASTM B62 – Standard Specification for Composition Bronze or Ounce Metal Castings

G. ASTM B88 – Standard Specification for Seamless Copper Water Tube.

H. ASTM D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing.

1.3 ACTION SUBMITTALS

A. Submit Shop Drawings for all underground service brass, corporations, curb stops and boxes, unions, couplings, and boxes, service saddles, water meters, and copper/polyethylene tubing.

B. Submit certifications regarding all iron or steel products that all manufacturing processes occurred in the US.

1.4 QUALITY ASSURANCE

A. All materials shall be provided by experienced firms who are qualified in the manufacture of the particular equipment to be furnished. The equipment shall be designed, constructed and installed in accordance with the best practices and methods and shall comply with these specifications as applicable.

B. All components specified in this section and supplied on the project shall be made in North America.

C. All materials used in conjunction with drinking water distribution systems shall be in accordance with ANSI/NSF 61.

D. All corporations, curb stops, couplings and adaptors shall meet the requirements of the Barnstable Water Supply District standards.

1.5 SYSTEM DESCRIPTION

A. In all cases, new water services shall consist of the following:

1. Tapping of the main

2. Service saddle (if larger than 1-inch)

3. Installation of a new corporation (diameters shall be 1 inch, unless specified otherwise) having a connection for copper/polyethylene tubing

4. Copper/polyethylene tubing from the main the curb stop

5. Curb stop and box

6. Connection

PART 2 PRODUCTS

2.1 AMERICAN IRON AND STEEL

A. All iron and steel products included in this section shall be manufactured in the US.

2.2 MATERIALS

A. General

1. All underground service brass including corporations, curb stops, couplings, fittings, adapters, and any other below ground fittings, shall be red brass manufactured to ASTM B62, and also meeting the requirements of AWWA C800 and meeting all current federal and state requirements for lead content.

B. Corporation Stops

1. Inlet Connection

a. The inlet shall be AWWA (CC) tapered threads

2. Outlet Connection

   a. Conductive compression for CTS O.D. tubing (straight-way) for copper tubing

   b. Quick joint nut with a tracer wire terminal for polyethylene tubing

3. Valve Operator Orientation

   a. The corporations shall be easy turning, non-binding and designed to open clockwise (right).

4. Ball-Type Corporation Stops

   a. Maximum working pressures up to 300 psig for sizes ¾-inch to 2-inch.

   b. Full-size waterway with coated ball for easy turning and full 360-degree stem rotation.

   c. 80 durometer Neoprene rubber seats sealing in both directions.

   d. Double o-ring stem seals with end piece o-ring providing secondary seal to prevent leakage.

   e. Blow-out proof stem design with stainless steel reinforced seat seal.

   f. Ball type corporations shall be as manufactured by Ford Meter Box Company, Red Hed Manufacturing Co., A.Y. McDonald Manufacturing Co., and Mueller Company.

C. Curb Stops

1. Inlet Connection

   a. Pack joint for polyethylene (PE) pipe

   b. Quick joint nut with a tracer wire terminal for polyethylene tubing

2. Outlet Connection

   a. Pack joint for polyethylene (PE) pipe

3. Valve Operator Orientation

   a. The corporation shall be easy turning, non-binding and designed to open clockwise (right).

4. Ball Style Curb Stop

   a. Shall be designed to withstand 300 psig working pressure.

   b. Solid one-piece tee head and stem.

   c. Double o-ring stem seals and coated brass ball supported by two Buna-N seats.

   d. The curb stop shall have a quarter turn stop (90-degree motion) requiring low turning torque allowing positive shut-off from either direction with check and no waste.

   e. Full round way provides straight through flow.

f. Minneapolis pattern with threads available for Minneapolis style curb box.

g. Ball style curb stops shall be as manufactured by Ford Meter Box Company, Red Hed Manufacturing Co., A.Y. McDonald Manufacturing Co., and Mueller Company.

D. Curb Boxes

1. Each curb stop shall be provided with a cast iron curb box and cover weighing a minimum of 15 pounds.

2. The curb box shall be the extension type with Arch pattern base. For valves larger than 1" diameter, the optional foot piece shall be provided.

3. The inside diameter of the upper section shall be at least 1¼ inches for Arch type and 2½ inches for Buffalo boxes.

4. Arch curb box shall be equipped with a 9/16 minimum diameter stationary extension rod (extending to within 18-inches of the top of the curb box) attached to the valve with a stainless steel or brass collar pin.

5. Boxes shall be completely and thoroughly coated with bitumastic paint.

6. Cover shall be Plug style with 27/32-inch brass pentagonal nut and the word "WATER" imprinted on it.

7. Cover shall include a terminal with a stainless-steel hex cap screw for attaching alligator clip if polyethylene tubing is used for connection of a tracer wire.

8. Curb boxes and covers shall be as manufactured by Ford Meter Box Company, A.Y. McDonald Manufacturing Co., or Mueller Company.

E. Unions, Couplings, and Connecting Adapters

1. Brass unions, couplings, and connecting adapters shall be as necessary for the type of piping or tubing being joined.

2. Provide electrical continuity.

3. Acceptable manufacturers include Ford Meter Box Company, Red Hed Manufacturing Co., A.Y. McDonald Manufacturing Co., and Mueller Company.

F. Service Saddles

1. Service saddles shall have a body with a CC threaded outlet and seal.

2. Service clamps shall be specifically sized for the particular water main pipe material.

3. Provide a drip-tight connection.

4. Connections to existing mains shall be performed using:

a. A bronze, double strap service clamp designed to fit the around the main pipe providing a uniform sealing pressure;

b. Service saddles shall be wide band type with stainless steel bands of 3.25-inch minimum width.

5. Bolts, nuts, and washers shall be stainless steel.

6. Straps shall be made of Type 304 stainless steel.

7. Acceptable manufacturers include Ford Meter Box Company, Smith-Blair Company, and Mueller Company.

G. Polyethylene Tubing

1. Polyethylene pipe shall be interior copper tube size (CTS) high density polyethylene PE3408 rated for 200 psi (SDR-9) working pressure in accordance with AWWA C-901, ASTM D-1248, and ASTM D-2737.

2. Insert stiffeners shall be used at all connections to brass fittings.

H. Tracer Wire

1. Provide tracer wire on all polyethylene water services from corporation to curb stop.

a. Tracer wire shall be AWG #12 solid copper conductor.

b. Jacketing material shall be very high molecular weight polyethylene (HMWPE) insulation no less than 5/64 inches (78 mils) thick.

c. THHN wire shall not be acceptable for use as a substitute for use as direct-bury tracer wire.

d. Tracer wire shall be as manufactured by BMS of Stoughton, MA, or equal.

2. No splices shall be allowed

PART 3 EXECUTION

3.1 INSTALLATION

A. A standard gooseneck (with generous sweeps, both horizontal and vertical) shall be provided at the corporation in conjunction with copper/polyethylene tubing to provide flexibility for settlement that might occur.

B. The new service pipe shall not have joints or connections other than needed at the corporation and the curb box. Contractor must provide 100-foot coils for services less than 100 feet from the water main. Fittings or unions are not allowed on services less than 100 feet in length.

C. The copper tubing shall be connected directly to the existing service pipe just past the new curb stop near the property line with appropriate adapters and compression couplings as necessary.

D. Curb stop and box shall be installed approximately at the property or street line in front of the property to be serviced.

E. Curb stops shall be placed a minimum of 3 feet behind all retaining walls, structures, etc. as directed by the Engineer as applicable. Where coring is required, a 4 inch sleeve shall be installed and extended one foot on either side of the structure.

F. Any existing services to be abandoned shall be crimped and the existing curb box removed.

G. Tracer Wire Installation

1. Start the tracer wire at the corporation stop, the tracer wire shall run through the tracer wire terminal with the screw tightened clamping the tracer wire. Leave 3 inches of length beyond the start of the tracer wire terminal.

2. From the corporation stop to the curb stop, run the tracer wire along the length of the polyethene tubing.

3. At the curb stop, the tracer wire shall run through the tracer wire terminal with the screw tightened clamping the tracer wire.

4. At the curb stop box, the tracer wire shall be clipped to the stainless-steel hex cap screw with enough slack in the tracer wire to allow removal of the curb box cover.

3.2 TESTING

A. Testing and disinfection of all water mains and services shall be in accordance with Sections 02501, Disinfection of Water Distribution Systems, and 02502, Testing of Water Distribution Systems.

B. The transfer of existing services to the new main shall not be completed until the new main has been tested, disinfected and approved by the Engineer.

C. All newly installed service connections shall be subject to line pressure in an open trench to determine tightness of joints before backfilling.

D. Plan the replacement work so that each service can be transferred, one at a time, keeping loss of water service to a minimum.

E. Complete service reconnection work on the same day it is started.

F. No service trench shall be backfilled before a Barnstable Water Department representative and the Engineer have observed and approved the work.

END OF SECTION

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SECTION 02530

MANHOLES AND CATCHBASINS

GENERAL

1.1 SUMMARY

A. Section Includes

1. Precast concrete manholes
2. Precast concrete catch basins
3. Cast iron manhole frames and covers
4. Cast iron catch basin frames and grates

B. Related Sections

1. Section 02503 - Testing of Sanitary Sewer and Storm Drainage Systems

1.2 REFERENCES

A. AASHTO – American Association of State Highway and Transportation Officials, Standard Specifications for Highways and Bridges, most recent edition

B. ASTM C32 - Standard Specification for Sewer and Manhole Brick (made from clay or shale)

C. ASTM A48 – Standard Specification for Gray Iron Castings

D. ASTM C150 – Standard Specification for Portland Cement

E. ASTM C207 – Standard Specification for Hydrated Lime for Masonry Purposes

F. ASTM C478 – Standard Specification for Precast Reinforced Concrete Manhole Sections

G. ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Piping Using Rubber Gaskets

H. ASTM C923 - Standard Specification for Resilient Connectors between Reinforced Concrete Manhole Structures, Pipes and Laterals

I. ASTM C990 – Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

1.3 SUBMITTALS

A. Submit Shop Drawings, showing all details of construction, including, but not limited to, structure dimensions, reinforcing, joints, and pipe connections to structures.

B. Submit on all materials and products included in this specification, including, but not limited to, manhole rungs, manhole frames and covers, dampproofing coating, brick masonry, mortar, non-shrink water-proof grout,

C. Submit weights of manhole frames and covers.

D. Submit design calculations including verification of adequate anti-flotation features and lateral earth pressures. Calculations shall verify that the manhole structure has been

designed to withstand the burial depth, submergence due to flooding, flotation, and dead and live loads.

1.4 QUALITY ASSURANCE

A. The quality of materials, the process of manufacture, and the finished sections shall be subject to inspection and approval by the Engineer, or other representative of the Owner. Such inspection may be made at the place of manufacture, or at the Site after delivery, or at both places, and the materials shall be subject to rejection at any time on account of failure to meet any of the Specification requirements, even though samples may have been accepted as satisfactory at the place of manufacture. Material rejected after delivery to the job shall be marked for identification and shall be removed from the job at once. Materials which have been damaged after delivery will be rejected, and if already installed, shall be acceptably repaired, if permitted, or removed and replaced, at no additional cost to the Owner.

B. At the time of inspection, the materials will be carefully examined for compliance with the latest ASTM designation specified and these Specifications, and with the approved manufacturer's drawings. Manhole sections will be inspected for general appearance, dimension, "scratch-strength," blisters, cracks, roughness, and soundness. The surface shall be dense and close-textured.

C. Imperfections in manhole sections may be repaired, subject to the approval of the Engineer, after demonstration by the manufacturer that strong and permanent repairs result. Repairs will be carefully inspected before final approval. Cement mortar used for repairs shall have a minimum compressive strength of 4,000 psi at 7 days and 5,000 psi at 28 days, when tested in 3 inch by 6 inch cylinders stored in the standard manner. Epoxy mortar may be utilized for repairs subject to the approval of the Engineer.

D. Personnel shall have confined space entry training as appropriate for the work to be performed.

E. Manholes shall be designed for lateral earth pressures and to resist flotation.

PART 2 PRODUCTS

2.1 PRECAST CONCRETE MANHOLE SECTIONS

A. Precast concrete barrel sections and transition top sections, shall conform to ASTM C478 and the following requirements:

1. The wall thickness shall not be less than 5 inches for 48 inch diameter reinforced barrel sections, 6 inches for 60 inch diameter reinforced barrel sections and 7 inches for 72 inch diameter reinforced barrel sections.

2. Top sections shall be eccentric except that flat top sections shall be used where shallow cover requires a top section less than 4 feet as shown on the Drawings.

3. Barrel sections shall have tongue and groove joints.

4. All sections shall be cured by an approved method and shall not be shipped nor subjected to loading until the concrete compressive strength has attained 3,000 psi and not before 5 days after fabrication and/or repair, whichever is longer.

5. Precast concrete barrel sections with precast top slabs and precast concrete transition sections shall be designed for a minimum of AASHTO HS20-44 loading plus the weight of the soil above at 120 pcf.

6. The date of manufacture and the name and trademark of the manufacturer shall be clearly marked on each precast section.

7. Precast concrete bases shall be monolithically constructed. The thickness of the bottom slab of the precast bases shall not be less than the barrel sections or top slab whichever is greater. Precast concrete bases shall be constructed with a 6 inch extended base, unless otherwise shown on the Drawings.

8. Knock out panels for piping shall be provided in precast sections at the locations shown on the Drawings. They shall be integrally cast with the section, 2½ inches thick and shall be sized as shown on the Drawings. There shall be no steel reinforcing in knock out panels.

9. The side wall height of the base section shall be a minimum of 12 inches above the top of the pipe coming into the manholes.

2.2 BRICK MASONRY

A. Bricks shall be good, sound, hard and uniformly burned, regular and uniform in shape and size, of compact texture. Underburned or salmon brick will not be acceptable and only whole brick shall be used unless otherwise permitted. In case bricks are rejected by the Engineer, they shall be immediately removed from the site of the work and satisfactory bricks substituted, at no additional cost to the Owner.

1. Bricks for the channels and shelves shall comply with the latest specifications of ASTM C32 for Sewer Brick, Grade SM.

2. Bricks for building up and leveling manhole frames shall conform to ASTM C32 Grade MS.

3. Poured concrete inverts will not be allowed.

B. Mortar used in the brickwork shall be composed of one part Type II portland cement conforming to ASTM C150 to two parts sand to which a small amount of hydrated lime not to exceed 10 lbs. to each bag of cement shall be added.

C. Sand used shall be washed, cleaned, screened, sharp and well graded as to different sizes and with no grain larger than will pass a No. 4 sieve. Sand shall be free from vegetable matter, loam, organic or other materials of such nature or of such quantity as to render it unsatisfactory.

D. Hydrated lime shall conform to ASTM C207, Type S.

2.3 MANHOLE FRAMES AND COVERS

A. Manhole frames and covers shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind. Manhole covers and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30B or ASTM A48, Class 35B.

B. Manhole covers shall have a diamond pattern, pickholes and the word "SEWER" or “DRAIN”, as appropriate, cast in 3 inch letters. Manhole frame and covers shall be manufactured by East Jordan Iron Works; Mechanics Iron Foundry; Neenah Foundry or equal.

C. Manhole frames and covers shall comply with the detail shown on the Drawings.

D. Manhole frames and covers shall be designed for a minimum of AASHTO HS20-44 loading.

2.4 CATCH BASIN FRAMES AND GRATES

A. Catch basin frames and grates shall be of good quality, strong, tough, even grained cast iron, smooth, free from scale, lumps, blisters, sand holes and defects of any kind which render them unfit for the service for which they are intended. Grate and frame seats shall be machined to a true surface. Castings shall be thoroughly cleaned and subject to hammer inspection. Cast iron shall conform to ASTM A48, Class 30B or ASTM A48, Class 35B.

B. The catch basin frames and grates shall comply with the details shown on the Drawings.

C. Catch basin frames and grates shall be designed for a minimum of AASHTO HS20-44 loading.

2.5 JOINTING PRECAST MANHOLE SECTIONS

A. Tongue and groove joints of precast manhole sections shall be sealed with a preformed flexible joint sealant. The preformed flexible joint sealant shall conform to ASTM C990.

2.6 MANHOLE RUNGS

A. Manhole rungs shall be drop front design, 14 inches wide with an abrasive step surface, steel reinforced, copolymer, polypropylene, plastic. Manhole rungs shall conform to OSHA requirements.

2.7 FLEXIBLE PIPE TO-STRUCTURE CONNECTORS

A. The flexible pipe-to-structure connectors shall be designed to provide a positive seal between the connector and the structure wall and between the connector and the pipe.

B. The flexible boot shall be manufactured of EPDM synthetic rubber in accordance with ASTM C443 and C923 and shall be 3/8 inch thick or greater.

C. The external bands shall be made entirely of 304 series non-magnetic stainless steel.

D. The flexible connectors shall be provided with a wedge-type or toggle-type expander to secure the pipe in the structure opening.

E. The flexible connectors shall meet the following criteria, in accordance with ASTM C923:

1. Shall not leak when subjected to a head pressure of 10 psi for 10 minutes.

2. Shall have the ability to deflect 7 degrees in any direction without leakage under the head pressure conditions described above.

3. Shall not leak when subject to a load of 150 lbs./in. pipe diameter and the head pressure conditions described above.

2.8 NON-SHRINK, WATER-PROOF GROUT

A. Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embeco; or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation

1. Construct manholes to the dimensions shown on the Drawings and as specified. Protect all work against flooding and flotation.

2. Set precast concrete barrel sections so as to be plumb and with sections in true alignment with a ¼ inch maximum tolerance to be allowed.

3. Install the precast sections in a manner that will result in a watertight joint. Seal the joints of precast concrete barrel sections with the preformed flexible joint sealant used in sufficient quantity to fill 75% of the joint cavity. Fill the outside and inside precast section joints with non-shrink grout and finish flush with the adjoining surfaces. Plug holes in the concrete barrel sections required for handling or other purposes with a non-shrink, water-proof grout or concrete and rubber plugs, and finish flush on the inside.

4. Backfilling shall be done in a careful manner, bringing the fill up evenly on all sides.

B. Pipe Connections

1. Stubs

a. Connect pipe stubs for future extensions to the structures as shown on the Drawings and close the stub end by a suitable watertight plug.

2. For pipes with smooth exterior surfaces (PVC, ductile iron, HDPE pressure pipe, steel, etc), use flexible pipe-to-structure connectors.

3. Where flexible pipe-to-structure connectors cannot be used, such as pipes with rough, irregular or corrugated exterior surfaces (concrete, corrugated metal, HDPE drainage pipe, etc):

a. After the new pipe has been set in place, completely fill the hole around the new pipe and structure with non-shrink, water-proof grout.

b. Place a 6 inch thick concrete encasement a total of 12 inches in length around the pipe stub adjacent to the exterior wall of the structure. Concrete shall have a 28 day compressive strength of 3,000 psi.

C. Manhole Rung Installation

1. Steel reinforced copolymer polypropylene plastic steps shall be press fitted by hand driven hammer into preformed holes in cured precast sections, on 12 inch centers, by the precast concrete manufacturer.

D. Brickwork

1. Mix mortar only in such quantity as may be required for immediate use and use before the initial set has taken place. Do not retain mortar for more than one and one-half hours and constantly work over with a hoe or shovel until used. Anti-freeze mixtures will not be allowed in the mortar. No masonry shall be laid when the outside temperature is below 40°F unless provisions are made to protect the mortar, bricks, and finished work from frost by heating and enclosing the work with tarpaulins or other suitable material. The Engineer's decision as to the adequacy of protection against freezing shall be final.

2. Construct channels and shelves of brick as shown on the Drawings. The brick channels shall correspond in shape with the lower half of the pipe. The top of the shelf shall be set at the elevation of the crown of the highest pipe and shall be sloped 1 inch per foot to drain toward the flow through channel. Construct brick surfaces exposed to sewage flow with the nominal 2 inch by 8 inch face exposed (i.e., bricks on edge).

3. Set manhole covers and frames in a full mortar bed and bricks, a maximum of 12 inches thick for conical tops and 6 inches thick for flat top sections, utilized to assure frame and cover are set to the existing grade. Reset the manhole frames and covers to final grade prior to placement of final paving.

3.2 LEAKAGE TEST

A. Leak test sewer manholes in conjunction with the pipeline in accordance with Section 02503.

3.3 CLEANING

A. Clean new manholes of silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

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SECTION 02532

STORMWATER TREATMENT UNIT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. The work covered by this section consists of the storm water sediment and oil separators. The Contractor shall furnish all equipment, tools, labor and materials necessary to complete the work in accordance with the plans and specifications

B. Related Sections

1. Section 02503 - Testing Storm Drainage Systems

2. Section 02530 - Manholes

1.2 SUBMITTALS

A. Submit Shop Drawings, showing details of construction, reinforcing, joints, pipe connections to structures and frames and grates.

B. Submit design calculations including verification of adequate anti-flotation features and lateral earth pressures. Calculations shall verify that the structure has been designed to withstand the burial depth, submergence due to flooding, flotation with ground water at the surface elevation, and dead and live loads. Calculations should verify that 80% total suspended solids will be removed on an average yearly basis. These calculations must be stamped by a Professional Engineer.

1.3 REFERENCE STANDARDS

A. ASTM D4097 - Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

B. ASTM C478 - Standard Specification for Pre-cast Reinforced Concrete Manhole Sections.

C. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, using Rubber Gaskets.

1.4 QUALITY ASSURANCE

A. The stormwater treatment unit shall remove oil and sediment from stormwater during wet weather events. Refer to Section 2.10 for performance requirements.

B. The stormwater treatment unit shall be Stormcepter STC 450i by Rinker, or approved equal.

1.5 HANDLING AND STORAGE

A. Care shall be taken in loading, transporting, and unloading to prevent damage to materials during storage and handling

PART 2 PRODUCTS

2.1 GENERAL

A. The stormwater treatment unit shall be circular and constructed from pre-cast concrete circular riser and slab components. The internal fiberglass insert shall be bolted and sealed watertight inside the reinforced concrete component.

2.2 PRECAST CONCRETE SECTIONS

A. Precast concrete barrel sections and transition top sections, shall conform to the requirements of Section 02530.

2.3 BRICK MASONRY

A. Bricks for building up and leveling frames and grates shall conform to ASTM C32 Grade MS, meeting the requirements of Section 02530.

2.4 FRAMES AND GRATES

A. Catch basin frames and grates shall meet the requirements of Section 02530.

2.5 JOINTING PRECAST MANHOLE SECTIONS

A. Tongue and groove joints of precast manhole sections shall be sealed with a preformed flexible joint sealant. The preformed flexible joint sealant shall conform to ASTM C990.

2.6 FLEXIBLE PIPE-TO-STRUCTURE CONNECTORS

A. The flexible pipe-to-structure connectors shall be designed to provide a positive seal between the connector and the structure wall and between the connector and the pipe.

B. The flexible boot shall be manufactured of EPDM synthetic rubber in accordance with ASTM C443 and C923 and shall be 3/8 inch thick or greater.

C. The external bands shall be made entirely of 304 series non-magnetic stainless steel.

D. The flexible connectors shall be provided with a wedge-type or toggle-type expander to secure the pipe in the structure opening.

E. The flexible connectors shall meet the following criteria, in accordance with ASTM C923:

1. Shall not leak when subjected to a head pressure of 10 psi for 10 minutes.

2. Shall have the ability to deflect 7 degrees in any direction without leakage under the head pressure conditions described above.

3. Shall not leak when subject to a load of 150 lbs/in. pipe diameter and the head pressure conditions described above.

2.7 FIBERGLASS

A. The fiberglass portion of the stormwater treatment unit shall be constructed in accordance with ASTM D-4097 Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.8 NON-SHRINK, WATER-PROOF GROUT

A. Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embeco; or equal.

2.9 PERFORMANCE

A. The stormwater treatment unit shall be designed to remove at least 80% of the suspended solids on an annual aggregate removal basis.

B. The stormwater treatment unit shall be equipped with an internal high flow bypass that regulates the flow rate into the treatment chamber and conveys high flows directly to the outlet so the scour and/or re-suspension of material previously collected in the separator does not occur.

C. The stormwater treatment units shall contain a fiberglass insert, bolted and sealed watertight to the inside of the bypass chamber to divert low to normal stormwater flows into the treatment chamber.

D. The difference between the inlet and outlet elevations shall be a minimum of 3-inches. The unit shall trap pollutants so they are not scoured away from the separator during backwater conditions.

E. The stormwater treatment unit shall be capable of removing 95% of floatable free oil.

F. The separator must be capable of trapping fine sand, silt, clay and organic particles in addition to larger sand, gravel particles and small floatables.

G. The stormwater quality treatment device shall be sized to a specific particle size distribution that is clearly identified in both diameter and specific gravity. The example below is a Fine Particle Size that is a common PSD used in design of water quality devices to ensure proper design for capturing smaller particles and the high load of associated pollutants.

Table 2.10 – Particle Size Distribution:

Amount	Diameter	Specific Gravity
20%	20 micron	1.3
20%	60 micron	1.8
20%	150 micron	2.2
20%	400 micron	2.65
20%	2000 micron	2.65

PART 3 EXECUTION

3.1 INSTALLATION

A. The stormwater treatment unit shall be constructed as shown on the Drawings and specified herein. Install at elevations and locations shown on the Drawings unless or as otherwise directed by the Engineer.

B. Place precast base units in accordance with Section 02530. The floor of the installed precast base section shall be checked for level at four prominent locations. Floor shall be within 0.50” of level.

C. All structural system components and system piping shall be made watertight.

D. Holes made for handling precast sections shall be filled with a nonshrink grout.

3.2 CLEANING

A. Clean new stormwater treatment unit of silt, debris and foreign matter of any kind, prior to final inspection.

END OF SECTION

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SECTION 02535

BREAKING INTO EXISTING MANHOLES AND CATCHBASINS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Breaking through the walls and inverts of existing manholes and catchbasins.

2. Connecting new pipes to existing structures.

3. Ancillary work associated with making the new connections to the existing structures.

1.2 REFERENCES

A. ASTM C443 – Standard Specification for Joints for Circular Concrete Sewer and Culvert Piping Using Rubber Gaskets.

B. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes and Laterals.

1.3 SUBMITTALS

A. Submit shop drawings showing pipe connection details.

1.4 QUALITY ASSURANCE

A. Personnel shall have confined space entry training as appropriate for the work to be performed.

PART 2 PRODUCTS

2.1 MATERIALS

A. Flexible Pipe-to-Structure Connectors

1. The flexible connectors shall be designed to provide a positive seal between the connector and the structure wall and between the connector and the pipe.

2. The flexible boot shall be manufactured of EPDM synthetic rubber in accordance with ASTM C443 and C923 and shall be 3/8 inch thick or greater.

3. The external bands shall be made entirely of 304 series non-magnetic stainless steel.

4. The flexible connectors shall be provided with a wedge-type or toggle-type expander to secure the pipe in the structure opening.

5. The flexible connectors shall meet the following criteria, in accordance with ASTM C923:

a. Shall not leak when subjected to a head pressure of 10 psi for 10 minutes.

b. Shall have the ability to deflect 7 degrees in any direction without leakage under the head pressure conditions described above.

c. Shall not leak when subject to a load of 150 lbs./in. pipe diameter and the head pressure conditions described above.

B. Non-shrink, water-proof grout

1. Non-shrink, water-proof grout shall be Hallemite; Waterplug; Embeco; or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Core drill into existing structures in such a fashion as to make an opening of suitable size to accommodate the connecting pipe without excessive damage to the existing structure.

B. Manholes

1. For manholes, break out and rebuild existing inverts as required to provide an adequate base under the new channels being installed, and shaped to provide smooth continuous hydraulic flow through the manhole.

2. Control existing flows as required during the period of construction. No sewage or drainage will be permitted to flow directly against concrete or other masonry work until it is at least 48 hours old.

a. Temporary handling of sewage or drainage flows may be accomplished by inserting pipes from the inlet to the outlet of the manhole and by using temporary plugs, where appropriate, provided that such pipes do not interfere with satisfactory completion of the work and shaping of the inverts, nor cause excessive backing-up in the existing system upstream of the diversion. In cases where this type of temporary handling of flows is not possible, provide the necessary dams, plugs, etc., as required in upstream manholes, and pump the flow around the structure under construction.

b. When sewage is pumped or otherwise diverted around a particular structure, it shall be discharged back into the sewage system through existing downstream manholes. Under no circumstances shall sewage be permitted to run onto the surface of the ground.

C. Catchbasins

1. All catchbasin openings, created as a result of the removal and replacement of the existing drains connected to the catchbasins with new drain pipes, shall be sealed. This work shall be performed using masonry to match existing construction, where applicable, and non-shrink grout to provide a neat patch.

D. Pipe Connections

1. Rebuild and tightly close existing manhole walls and inverts and catchbasin walls to provide an integral, water-tight structure around the new pipes.

2. For pipes with smooth exterior surfaces (PVC, ductile iron, HDPE, steel, etc), use flexible pipe-to-structure connectors.

3. Where flexible pipe-to-structure connectors cannot be used, such as pipes with rough, irregular or corrugated exterior surfaces (concrete, corrugated metal or HDPE, etc):

   a. After the new pipe has been set in place, completely fill the hole around the new pipe and structure with non-shrink, water-proof grout.

   b. Place a 6 inch thick concrete encasement a total of 12 inches in length around the pipe stub adjacent to the exterior wall of the structure. Concrete shall have a 28 day compressive strength of 3,000 psi.

END OF SECTION

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SECTION 02740

BITUMINOUS CONCRETE PAVEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Hot mix Asphalt (HMA) paving

2. Porous Pavement

3. HMA Sidewalk

B. For the purposes of this Section, Hot Mix Asphalt (HMA) and bituminous concrete have the same meaning.

C. Related Requirements

1. Section 02315 - Excavation, Backfill, Compaction and Dewatering

2. Section 02760 - Pavement Markings

1.2 REFERENCES

A. Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 Edition as amended

B. ASTM D2041 - Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures

C. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1990 Edition, as amended

D. AASHTO M 320

E. AASHTO T 96 – L.A. Abrasion Test

F. AASHTO T 195 (Ross Count)

G. TAI - (The Asphalt Institute) - MS-3 Asphalt Plant Manual

H. TAI - (The Asphalt Institute) - MS-8 Asphalt Paving Manual

1.3 SUBMITTALS

A. Job mix formula for each mix specified under this Section.

B. Product data sheets for all additives proposed in the mix design.

C. Certificate indicating the mixes specified meet or exceed the requirements specified herein.

D. Certificate indicating the mix plant conforms to TAI Manual MS-3, Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 Edition as amended

E. Equipment Data Sheets for all equipment proposed for use placing the Hot Mix Asphalt (HMA).

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with TAI Manual MS-8., Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 Edition as amended

B. Mixing Plant: Conform to TAI Manual MS-8., Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 Edition as amended

C. Obtain materials from same source throughout.

D. Prior to placing permanent HMA, hold a pre-paving meeting on the Site. All parties directly involved in the preparation and placement of permanent HMA on the Project shall attend, including but not limited to the paving subcontractor(s) project manager(s), QC representative, crew foreman, General Contractor's Superintendent, and the Engineer.

E. Material samples shall be taken at the plant for every 500 tons or daily, whichever is more frequent, and analyzed for asphalt content and theoretical maximum density. Test results from the design mix material will not be accepted.

F. Schedule crews and equipment to perform rolling operations in accordance with the heat flow model outlined in the latest version of the paving software "PaveCool," developed by University of Minnesota and weather data input into the software. Weather data shall be gathered approximately 12 hours prior to paving operations, using the website, www.weather.com, for forecasted conditions for the time of paving.

PART 2 PRODUCTS

2.1 MATERIALS

A. General

1. Bituminous materials shall conform to the requirements of these Specifications.

2. Bitumen delivered to the Project or to a mix plant must be accompanied by a proper certificate signed by the producer's authorized representative. Shipments of material not accompanied by a certificate will not be accepted for use in the Work.

B. Hot Mix Asphalt Paving shall be Class I, Type I-1, as specified in Sections 460 and M3.11.0 of the above referenced Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 edition, as amended.

C. Hot Mix Asphalt

1. These mixtures shall be composed of mineral aggregate, mineral filler (if required), bituminous material, and reclaimed asphalt pavement (RAP). The use of RAP shall be at the Contractor's option unless otherwise provided by the special provisions of the contract.

2. Plants producing recycled mix shall be equipped so that they can properly proportion, blend and mix all components of a recycled mixture so that the end product is in conformance with the designated job-mix formula.

3. The mineral aggregate, filler (if required), bituminous material, asphalt modifier (if required) and RAP shall be proportioned and mixed to conform with the designated mixture as tabulated in Table A hereafter.

4. In order to obtain standard texture, density and stability, provide a specific Job-Mix Formula for the particular uniform combination of materials and sources of supply to be used on the Project. The Job-Mix Formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate and for batch plants, the number of seconds for dry mixing time and the number of seconds for wet mixing time. AASHTO T 195 (Ross Count) with a coating factor of 98% will be used when necessary to evaluate proper mixing time. The Job-Mix Formula shall also specify a single source or uniform blend of particular sources for fine aggregate, a single source for each nominal size of coarse aggregate, a single source of supply for minor filler and sources for asphalt. The Job-Mix Formula shall bind the Contractor to furnish paving mixtures not only within the master ranges, but also conforming to the exact formula thus set up for the Project, within allowable tolerances as follows:

No. 4 and larger sieve	±7.0%
No. 8 and smaller sieves, except No. 200	±4.0%
Passing No. 200 sieve	±2.0%
Asphalt	±0.4%

TABLE A
PERCENT BY MASS PASSING SIEVE DESIGNATION

Standard Sieves	HMA Base Course	HMA Binder Course	HMA Dense Binder Course	HMA Top Course	HMA Modified Top Course	HMA 3/8" Modified Top Course	HMA Dense Mix	Porous Pavement.
2 in.	100							
1 in.	57-87	100	100		100	100		
3/4 in.		80-100	80-100		95-100	100		100
5/8 in.				100				
1/2 in.	40-65	55-75	65-80	95-100	79-100	95-100	100	85-100
3/8 in.				80-100	68-88	68-88	80-100	55-75
No. 4	20-45	28-50	48-65	50-76	48-68	48-68	55-80	10-25
No. 8	15-33	20-38	37-49	37-49	33-46	33-53	48-59	5-15
No. 16				26-40	20-40	20-40	36-49	
No. 30	8-17	8-22	17-30	17-29	14-30	14-30	24-38	
No. 50	4-12	5-15	10-22	10-21	9-21	9-21	14-27	
No. 100*				5-16	6-16	6-16	6-18	
No. 200	0-4	0-5	0-6	2-7	2-6	2-6	4-8	2-4
Bitumen	4-5	4.5-5.5	5-6	5.6-7.0	5.1-6	5-6	7-8	5.8-6.5

*Percentages shown in table above for aggregate sizes are stated as proportional percentages of total aggregate for the mix.
Unless authorized by the Engineer, no Job-Mix Formula will be approved which specifies:
Less than 6% binder for HMA Top Course
Less than 5.5% binder for HMA 3/8" Modified Top Course and HMA Modified Top Course for mixes containing RAP.

Should a change of sources of materials be made, a new job mix formula shall be established by the Contractor before the new material is used. When unsatisfactory results or other conditions make it necessary, the Engineer may establish a new Job-Mix Formula.

The aggregate will be accepted in stockpile at the plant site. The bituminous material will be accepted on certification. If the Contractor elects to furnish HMA from more than one plant, the job mix formula must be adhered to by all plants.

5. The use of RAP will be permitted at the option of the Contractor and provided that the end product is in conformance with the designated Job-Mix Formula. The proportion of RAP to virgin aggregate shall be limited to a maximum of 40% for drum mix plants and 20% for modified batch plants. The maximum amount of RAP for surface courses shall be 10%.

6. Two or more Job-Mix Formulas may be approved for a particular plant; however, only material conforming to one Job-Mix Formula will be permitted to be used on any given calendar day. The Job-Mix Formula shall bind the Contractor to furnish paving mixtures not only within the master ranges, but also conforming to the exact formula thus set up for the Project.

7. Coarse Aggregate

   a. The coarse mineral aggregate shall be clean, crushed rock consisting of the angular fragments obtained by breaking and crushing shattered natural rock, free from a detrimental quantity of thin or elongated pieces, free from dirt or other objectionable materials, and shall have a percentage of wear, as determined by the Los Angeles Abrasion Test (AASHTO T 96), of not more than 30. It shall be surface dry and shall have a moisture content of not more than 0.5% after drying. The use of crushed gravel stone will not be permitted.

8. Fine Aggregate

a. The fine aggregate shall consist of one of the following:

1) 100% Natural Sand

2) 100% Stone Sand

3) A blend of sand and stone screenings the proportions of which shall be approved by the Engineer

4) A blend of natural sand and stone sand

b. Natural sand shall consist of inert, hard, durable grains of quartz or other hard, durable rock, free from topsoil or clay, surface coatings, organic matter or other deleterious materials. When the primary source of material, passing the No. 200 sieve, is obtained from natural sand, these fines must be approved prior to use.

c. Stone sand shall be a processed material prepared from stone screenings to produce a consistently graded material conforming to specification requirements.

d. The stone screenings shall be the product of a secondary crusher and shall be free from dirt, clay, organic matter, excess fines or other deleterious material.

e. The fine aggregate as delivered to the mixer shall meet the following requirements:

	Percent Passing	
Sieve Designation	Minimum	Maximum
3/8 in.	95	100
No. 8	70	95
No. 50	20	40
No. 200	2	16

f. In the fine aggregate sieve analysis (passing No. 8), the amount between two successive sieves (No. 16, No. 30, No. 50 and No. 100) shall not exceed 33% of the fine aggregate total.

g. Plants that experience a large variation in the quality and gradation of their primary fine aggregate sources and have difficulty in consistently providing fine aggregate that conforms to the requirements of this specification, shall be equipped with an approved fine aggregate system for processing fine aggregate that *will* meet the requirements of this specification.

D. Reclaimed Asphalt Pavement (RAP)

1. Reclaimed Asphalt Pavement (RAP) shall consist of the material obtained from highways or streets by crushing, milling or planing existing pavements. This material shall be transported to the mix plant yard and processed through an approved crusher so that the resulting material will contain no particles larger than 1½ inches. The material shall be stockpiled on a free draining base and kept separate from the other aggregates. The material contained in the stockpiles shall have a reasonably uniform gradation from fine to coarse and shall not be contaminated by foreign materials.

E. Mineral Filler

1. Mineral filler shall consist of approved Portland Cement, limestone dust, hydrated lime, stone float or stone dust. Stone dust shall be produced from crushed ledge stone and shall be the product of a secondary crusher so processed as to deliver a product of uniform grading. Mineral filler shall completely pass a No. 50 sieve and at least 65% shall pass a No. 200 sieve.

F. Bituminous Materials

1. The asphalt cement for the mixture shall be the grade designated by the Engineer and shall conform to the requirements of M3.01.01. When required an approved anti-stripping additive conforming to M3.10.0 shall be added to the asphalt cement.

2. The asphalt for the porous pavement mixture shall be the grade designated by the Engineer and shall conform to the requirements of M3.01.2 for polymer modified and M3.01.2 for modified asphalt rubber.

3. Asphalt mixture for porous pavement shall be designed in accordance with AASHTO R 113 and conform with requirements of M3.06.4-7.

4. Tack coat shall consist of either emulsified asphalt, Grade RS-1 conforming to Section M3.03.0.

5. For any bituminous mixture containing RAP, submit in addition to the Job-Mix Formula, the amount and type of asphalt modifier to be added to the mixture to restore the asphalt properties of the RAP to a level that is reasonably consistent with the requirements of current specifications for new asphalt. The restored asphalt when recovered by the Abson Method from the recycled mixture shall have a minimum penetration at 77 degrees Fahrenheit of 50 and a maximum absolute viscosity at 140 degrees Fahrenheit of 800 pascal seconds.

6. Only Performance Graded Asphalt Binder grades PG 64-28 or PG 52-34 will be used as modifiers and shall meet the requirements of AASHTO M 320.

PART 3 EXECUTION

3.1 PAVING – GENERAL

A. Maintain pavement under this Contract during the guarantee period of one year and promptly (within 3 days of notice given by the Engineer) refill and repave areas which have settled or are otherwise unsatisfactory for traffic.

B. All pavement thicknesses referred to herein are compacted thicknesses. Place sufficient mix to ensure that the specified thickness of pavement results.

C. Paving operations shall be conducted so that there is no physical or thermal segregation of the hot mix asphalt material during transport or placement of the mix. Should segregation be observed by the Engineer, suspend paving operations immediately. The Engineer may reject material, which appears to be defective based on observation. Such rejected material shall not be used in the Work and shall be removed and replaced by the Contractor at no additional cost to the Owner.

D. Existing drainage patterns shall not be altered by the new pavement construction unless otherwise shown on the Drawings.

E. Furnish and spread calcium chloride on disturbed surfaces to control dust conditions when necessary, or upon direction of the Engineer.

F. No permanent mixtures shall be placed when the air temperature is below 40 degrees Fahrenheit, or when the material on which the mixtures are to be placed contains frost or has a surface temperature that the Engineer considers too low.

G. When the air temperature falls below 50 degrees Fahrenheit, extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials and placing and compacting the mixtures.

H. Pavement markings damaged during the course of the work shall be repaired in accordance with Section 02760.

I. In no case will pavement be placed until the gravel base is dry and compacted to at least 92.0% maximum density at optimum moisture content.

J. All pavement edges that have been damaged shall be sawcut again if necessary to re-establish a straight clean line between the existing pavement and trench patch.

K. Tack Coats

1. Perform a test pass with tack truck. Test pass shall be used to determine how long the tack coat needs to cure prior to beginning paving operations and for operator to adjust spray bar and nozzles as necessary. Tack shall be uniformly sprayed; "streaking" will not be allowed. Placement of top course shall not occur until the tack coat cures or "breaks," with color changing from brown to black.

2. The edges of the existing pavement where the joints are to be formed shall be thoroughly coated with tack coat to ensure adhesion between the two pavements.

3. The contact surfaces of curbs, castings, and other structures shall be painted with a tack coat prior to placement of paving.

L. Top course mixes for porous pavement shall provide for 16%-19% in place air void content, all other top course mixes shall provide for 4% air voids in the finished product with the initial in-place voids not exceeding 7.5%. Final in-place voids for non-porous mix shall not be below 2.5%. Additional asphalt content shall not be added for the sole purpose of reducing the in-place voids. If the in-place voids are too high or the paving is expected to occur during cold weather, more compactive effort will be required to adjust the void content rather than increasing the asphalt content.

M. Breakdown rolling shall not occur before the HMA has cooled to a temperature of 320 degrees Fahrenheit, and shall be completed before the HMA mat has cooled to a temperature of 275 degrees Fahrenheit. Intermediate rolling shall be completed prior to the HMA mat attaining a temperature of 200 degrees Fahrenheit. Finish rolling shall be completed prior to the HMA mat attaining a temperature of 150 degrees Fahrenheit. Roller and paver speeds shall be agreed upon with the Engineer prior to placing HMA to ensure mix temperature requirements will be met.

N. Thermal segregation of the HMA shall be limited to a maximum of 20 degrees Fahrenheit.

O. Cascading HMA material on the top of the finished mat with rakes or shovels will not be permitted. Coarse Aggregate dislodged as a result of unavoidable hand work shall be removed from the surface prior to rolling.

P. Place and compact HMA materials by steel-wheeled rollers of sufficient weight to compact the HMA to 92.5% of the calculated Theoretical Maximum Density (TMD) in accordance with ASTM D2041.

Q. Along curbs, structures and all other places not accessible with a roller, the paving mixture shall be thoroughly compacted with tampers. Such tampers shall not weigh less than 25 pounds and shall have a tamping face no more than 50 square inches in size. The surface of the mixture after compaction shall be smooth and true to the established line and grade.

R. No vehicular traffic shall be permitted on the newly completed pavement until adequate stability has been attained and the material has cooled to below 140 degrees Fahrenheit or sufficiently to prevent distortion or loss of fines. HMA delivery trucks (loaded or empty) shall not be permitted on the newly completed pavement until the asphalt has cooled to below 90 degrees Fahrenheit. If the climatic or other conditions warrant, the period of time before opening to traffic may be extended at the discretion of the Engineer.

S. Following all paving, the area along the edge of all pavement shall be backed up with gravel, or loam and seed as required, so that it is flush with the adjacent paving. Whenever possible, the final surface of the backup material shall slope away from the surface edge for drainage runoff.

T. Following all paving, clean all catch basins and remove and dispose of all debris.

3.2 PAVING – HMA PAVING

A. Prior to placing full-width permanent HMA, notify Engineer of the intended work area at least 24 hours prior to start of work, so that Engineer can adequately inform residents regarding impacts to road access, driveways, detours, and work hours.

B. When placing permanent HMA, a pneumatic tired roller shall be used for intermediate rolling on each lift. Three rollers will be required for these roads with the pneumatic tired roller being used between the breakdown roller and the finish roller. The pneumatic tired roller shall not be used as a breakdown roller. In addition to compaction, the purpose of this roller will be to provide a more tightly-knit, traffic resistant surface.

3.3 PAVING – BASE AND BINDER COURSE

A. Place base and/or binder course as soon as possible after the gravel base has been prepared, shaped and compacted for all streets.

B. Binder course shall be placed on reclaimed or fully reconstructed roads as shown on the Drawings and as specified herein in preparation for the full-width top course.

C. Maintain base and/or binder course in a condition suitable for traffic throughout the construction period. Defects shall be repaired within 3 days of notification.

D. Prepare the base and/or binder course for placement of the top course. The base shall be graded prior to the placement of the binder course. The binder course shall be regraded, placing additional HMA where settling has occurred, repairing the existing surface and replacing broken or damaged sections at no additional cost to the Owner. The binder course surface shall be in all respects acceptable to the Engineer before the final pavement is placed. The surface shall then be broom cleaned.

3.4 HMA SIDEWALK AND BASE COURSE

A. Permanent repairs shall not be performed until a period of 90 days, or such other period as determined by the Engineer, has elapsed.

B. Remove a sufficient depth of the temporary surfaces and gravel to provide for the thickness of surface specified. The gravel surface thus exposed shall be fine graded and thoroughly compacted using mechanical tampers. The edges of the existing surface that will abut the repair shall be trued up and cut to smooth and even lines at this time. Cutting shall be done with a saw. The existing paved surface shall be cut to firm ground that has not sloughed or sagged into or toward the excavation.

C. Top mix shall then be placed in the thickness specified in the Drawings and compacted to a point below the surrounded area to allow the second course to be placed flush with the existing sidewalk. A second course of dense mix shall then be placed at the thickness specified in the Drawings to bring the repaired sidewalk surface to grade.

D. Repair shall be neat in appearance and shall blend in with the existing adjoining pavement.

3.5 HMA POROURS PAVEMENT

A. Porous pavement shall be placed in two uniform thick lifts as soon as possible after the sub base has been prepared, shaped and compacted for all areas.

B. Minimize equipment and vehicle traffic on the first course throughout the construction period. Defects shall be repaired within 3 days of notification.

C. Prepare the first course for placement of the top course. The first course shall be regraded, placing additional HMA where settling has occurred, repairing the existing surface and replacing broken or damaged sections and be broom cleaned at no additional cost to the Owner. The first course surface shall be in all respects acceptable to the Engineer before the final pavement is placed. The top surface shall then be broom cleaned and maintained free of sediment throughout the project.

3.6 QUALITY CONTROL

A. Provide a written Quality Control Plan (QCP) for the Project. As a minimum, the QCP shall contain the following information:

1. QCP shall be contract specific, stating how the contractor proposes to control the materials, equipment, and construction operations including subcontractors and suppliers as well as production facilities and transportation modes to the Project for the HMA pavement operations.

2. The QCP shall be submitted no later than 15 days prior to commencing the paving operations.

3. The QCP shall contain the name, telephone number, duties, and employer of all quality control personnel necessary to implement the QCP. A Quality Control Technician (QCT) shall be required. The person(s) responsible for conducting quality control and inspection activities to implement the QCP. There may be more than one QCT on a project.

4. The Engineer may require the replacement of ineffective or unqualified equipment or Quality Control personnel. Construction operations may be required to stop until Quality Control corrective actions are taken.

B. All roller operators shall use infrared pistol thermometers to measure the temperature of the mat during rolling operations.

3.7 ACCEPTANCE

A. When placing permanent HMA, in-place density shall be evaluated by comparing the in-place density to the TMD. The TMD shall be determined using an actual sample of plant produced HMA for production placement according to ASTM D2041 - 03a Standard Test Method for Theoretical Maximum Specific Gravity and Density of Bituminous Paving Mixtures. The TMD shall be calculated each day. The TMD calculated during the mix design will not be accepted. A nuclear density gauge may be used for spot checking in-place density and developing roller patterns but acceptance testing will be solely based bulk density measurement of cores taken from the final in-place mat.

B. One core sample is to be taken for every 9000 square yards, per lift, or at least one per street, per lift (whichever is greater), at a location randomly selected by the Engineer. Cores taken for the purpose of acceptance testing shall extend the full depth of the pavement structure. Cores shall be taken no sooner than the day following placement of the HMA. The core shall be allowed to air dry 24 hours prior to measuring density. Drying in an oven will not be permitted. Pavement at core locations shall be repaired with new HMA and made consistent with adjacent surfaces with infrared technology.

C. Acceptance testing shall prove density of the HMA to be at least 92.5% of the TMD, not to exceed 97%.

END OF SECTION

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SECTION 02760

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. All labor, materials, accessories, service and equipment necessary to furnish and apply all pavement striping, parking stalls, and traffic markings as indicated on the Drawings and as specified herein.

a. New painted pavement markings

b. Replacement of pavement markings disturbed as part of construction activities

B. Related Sections

1. Section 02740 - Bituminous Concrete Pavement

1.2 REFERENCES

A. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1986 Edition, as amended.

B. Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 Edition, as amended.

1.3 SUBMITTALS

A. Submit affidavit stating submitted materials comply with the above-noted Standards.

1.4 WARRANTY

A. Provide a written one-year unconditional guarantee against fading, chipping, peeling, wearing, etc.

PART 2 PRODUCTS

2.1 MATERIALS

A. Waterborne Pavement Marking Paint

1. In accordance with the Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 Edition, as amended, pavement marking paint shall conform to the requirements of Articles M.7.01.10 and M.7.01.11 for waterborne pavement marking paint.

2. All paint for parking stall and traffic markings shall be fast drying white or yellow traffic paint complying with the applicable paragraphs of the Standard Specifications. The paint shall be capable of being applied to bituminous and portland cement concrete pavements with striping equipment that does not require heating above ambient temperatures.

3. The following additional pavement marking paint requirements shall be met:

a. The total nonvolatile content shall not be less than 70% by weight.

b. Pigment shall be 45-55% by weight.

c. Weight per gallon shall not be less than 12.5 pounds.

d. Drying time to no pickup shall be 15 minutes.

4. No reflective glass beads will be required.

5. The material shall not lift from the pavement in the freezing weather, and shall not smear or spread under normal traffic conditions or at temperature below 120 degrees F.

6. The paint shall not deteriorate by contact with sand, sodium, chloride, calcium chloride or other chemicals used against the formation of ice on the pavement, because of the oil content of pavement materials, or from gasoline, grease and oil drippings from vehicles.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect the building, walks, pavement, curbing, trees, shrubs, mulch, etc. from over-spray of paint and damage.

B. Clean and sweep all areas to be striped or re-striped of all sand, dirt, grease, oil, etc. Large areas of tar, grease or foreign materials may require sand blasting, steam cleaning or power brooming to accomplish complete removal.

C. Application of markings shall not proceed until authorization is received from Engineer.

D. Bituminous concrete pavements shall have been in place for at least 7 days prior to the application of pavement markings.

3.2 INSTALLATION

A. Installation shall be by skilled workers who are experienced and normally employed in the Work of installing pavement markings.

B. All permanent pavement repair areas shall be repainted to match the original pavement markings.

C. New pavement markings shall be as shown on the Drawings and as specified herein.

D. Painting shall be in accordance with Section 860 of the Massachusetts DPW “Standard Specifications for Highway and Bridges”, 1988 Edition, as amended.

E. All stripes shall be applied one coat with brush, spray or marking machine over dry clean pavement only.

F. All paint shall be installed at a rate of not more than 300 linear feet of 4- inch wide lines per gallon of paint (approximately 0.016 inch dry film thickness).

G. If material is applied to the pavement by an extrusion method, one side of the shaping die shall be the pavement and the other three sides are contained by, or are part of, suitable equipment for controlling the flow of paint.

H. All stalls shown on the plan are to be "single stripe,” and shall be spaced equally, each stall being separated from the next by a single line marking the stall width. The line indicated on the Drawings is on the center line of the stall striping. The line between rows of stalls shall be a single line.

I. Where entire areas are to be cross-hatched as directed by the Drawings, the 4-inch-wide straight white parallel stripes 36 inches on center shall be laid out and painted in solid lines.

J. After application and proper drying time, the material shall show no appreciable deformation or discoloration under traffic conditions and in air and/or road temperature ranging from 0 - 120 degrees F.

K. The stripe shall maintain its original dimensions and placement. The exposed surface shall be free from tack. Cold ductility of the material shall permit normal movement with the pavement surface without chipping or cracking.

L. No paint or pavement marking material shall be heated above the temperature allowed per manufacturer's instructions.

M. All painting shall be performed in a neat and workmanlike manner.

N. Lines shall sharp and clear with no feathered edging or fogging.

O. If, for any reason, material is spilled or tracked on the pavement or any markings applied by Contractor, in Engineer's judgment, are not acceptable, then the Contractor shall remove such material by a method that shall not damage the roadway surface and is acceptable to Engineer, clean and prepare the surface for a reapplication of markings, and reapply the markings as directed.

P. Application Requirements

1. Marking paint shall be applied at a rate of 100 to 115 square feet per gallon.

2. Material application temperature shall be from 40°F to 120°F.

3. No thinners shall be used for the above listed pavement marking applications except in accordance with the manufacturer's specifications and at the direction of the Engineer.

4. Minimum finished paint thickness shall be 15 mils.

3.3 PROTECTION

A. Markings shall remain protected until sufficiently dry to bear traffic on roadways that are open to traffic.

B. Precautions shall be taken to prevent tracking by tires of the striping equipment.

C. Traffic cones used for protection of markings shall be not less than 28 inches in height.

END OF SECTION

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SECTION 02770

GRANITE CURBING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Vertical Granite Curbing

B. Related Sections

1. Section 02320, Borrow Material

2. Section 03300, Cast-In-Place Concrete

1.2 REFERENCES

A. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1986 Edition, as amended.

B. Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 Edition, as amended.

1.3 SUBMITTALS

A. Submit to the Engineer, shop drawing showing dimensions, layouts and details of construction and accessories required.

PART 2 PRODUCTS

2.1 MATERIALS

A. Granite Curbing

1. In accordance with the Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 Edition, as amended, granite curbing shall conform to the requirements of Article M.9.04.1.

2. Granite curbing shall be hard and durable, fundamentally of light color, of general uniform texture, of smooth splitting appearance, and free from seams or imperfections.

3. No top projections of greater than 1/8 inch shall exist, and no more than 1” projections shall exist on the back and bottom of each section.

4. Vertical Granite Curbing

a. Granite curbing shall be Type VB in accordance with Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 Edition, as amended.

b. Standard laying length shall be no less than 6-feet.

c. Standard laying length shall be no less than 2-feet.

B. Mortar

1. In general, mortar shall be one part Portland cement and two parts (by volume) dry fine aggregate.

2. Hydrated lime in an amount of less than 4 pounds of lime to each bag of Portland cement may be added if approved by the Engineer.

C. Gravel Base

1. Processed gravel base shall be as specified in Section 02320 (Borrow Materials).

D. Concrete Base

1. Fill concrete shall be Massachusetts Department of Transportation (formerly MHD) Standard 3000 psi mix.

2. Concrete fill shall meet the requirements of Section 03300 (Cast-In-Place Concrete).

PART 3 EXECUTION

3.1 INSTALLATION

A. All granite curbing, inlets, and corners shall be installed in accordance with the "Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highway and Bridges 1988, as amended.

B. Excavation shall be made of sufficient depth and width to accommodate the granular base.

C. The line of the curbing shall be set straight and true for the full depth.

D. Granite edging shall be set on an 8 inch minimum depth compacted processed gravel base. The gravel base shall be fine graded and thoroughly compacted with approved mechanical compactors. Concrete fill shall be placed on the front and back of the granite curbing in lieu of gravel backfill in locations where a sidewalk does not directly abut the back of the curb. In locations where a sidewalk directly abuts the back of the curb, concrete fill is only required on the front side.

E. All granite edging shall have a 4 inch reveal from the finished pavement surface, except in the case of transition curbing, and shall be flush with adjacent sidewalks.

F. Where edging is to be set on a radius between 10 feet and 160 feet, the maximum laying length shall be 3 foot. Where edging is to be set on a radius of 10 feet or less, the maximum laying length shall be 1 foot.

G. The joints of all granite curbing shall be filled with cement mortar and neatly pointed on exposed surfaces. The joints of the stone curbing shall be pointed with mortar for the full depth of the curbing. Excess mortar shall be satisfactorily cleaned from the curb.

H. At approximately 50-foot intervals, a ½ inch joint shall not be filled with mortar to be left free for expansion.

I. The joints of all granite curbing shall be filled with cement mortar and neatly pointed on exposed surfaces. Excess mortar shall be satisfactorily cleaned from the curb.

3.2 REMOVING AND RESETTING GRANITE CURBING

A. Remove curbs without causing damage.

B. Store curbs removed in a manner that protects them from damage or discoloration. Replace curbs that are lost or damaged.

C. Reset curbs in accordance with Section 500 of the "Commonwealth of Massachusetts Department of Public Works Standard Specifications for Highway and Bridges 1988, as amended.

END OF SECTION

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SECTION 02771

BITUMINOUS CONCRETE BERM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Bituminous concrete berm

2. For the purposes of this Section, berm and curb have the same meaning.

1.2 REFERENCES

A. Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 Edition as amended

B. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1990 Edition, as amended

C. ASTM D446 – Standard Specifications and Operating Instructions for Glass Capillary Kinematic Viscometers

D. ASTM D2939 – Standard Test Methods for Emulsified Bitumens Used as Protective Coatings

E. AASHTO T 96 – L.A. Abrasion Test

F. AASHTO T 195 (Ross Count)

G. TAI - (The Asphalt Institute) - MS-3 Asphalt Plant Manual

H. TAI - (The Asphalt Institute) - MS-8 Asphalt Paving Manual

1.3 SUBMITTALS

A. Product information and mix design for each mix specified under this Section.

B. Sieve analysis and L.A. Abrasion test results for aggregate proposed for use in the various mixes specified.

C. Product data sheets for all additives proposed in the mix design.

D. Certificate indicating the mixes specified meet or exceed the requirements specified herein.

E. Certificate indicating the mix plant conforms to Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges."

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges."

B. Mixing Plant: Conform to Commonwealth of Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges."

C. Obtain materials from same source throughout.

PART 2 PRODUCTS

2.1 MATERIALS

A. General

1. Bituminous materials shall conform to the requirements of these Specifications.

B. Bituminous Concrete Berm shall be Class I, Type I-1, as specified in Sections 470 and M3.11.0 of the above referenced Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 edition, as amended.

C. Tack coat shall consist of either emulsified asphalt, Grade RS-1 conforming to Section M3.03.0.

PART 3 EXECUTION

3.1 PAVING – GENERAL

A. Install bituminous concrete pavement in accordance with Section 460 of the Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges", 1988 edition, as amended.

B. Paving operations shall be conducted so that there is no physical or thermal segregation of the hot mix asphalt material during transport or placement of the mix. Should segregation be observed by the Engineer, the Contractor shall suspend paving operations immediately. The Engineer may reject material, which appears to be defective based on inspection. Such rejected material shall not be used in the work and shall be removed and replaced by the Contractor at no additional cost to the owner.

C. No mix shall be placed on wet or damp surfaces.

D. When the air temperature falls below 50ºF, extra precautions shall be taken in drying the aggregates, controlling the temperatures of the materials and placing and compacting the mixtures.

E. No mixtures shall be placed when the air temperature is below 40ºF, or when the material on which the mixtures are to be placed contains frost or has a surface temperature Engineer considers too low.

F. Regardless of any temperature requirements, no mix conforming to the requirements of these specifications shall be placed after October 31 or before May 1 of any year.

G. Prepare the binder course for placement of the bituminous concrete berm. The binder course shall be regraded, placing additional bituminous concrete where settling has occurred, repairing the existing surface and replacing broken or damaged sections at no additional cost to the Owner. The binder course surface shall be in all respects acceptable to the Engineer before the berm is placed. The surface shall then be broom cleaned.

H. Apply tack coat to surfaces receiving berm for proper adhesion of the new bituminous concrete pavement to the existing.

I. Following all paving, the area along the berms shall be backed up with gravel, or loam and seed as required, so that it is flush with the adjacent paving. Whenever possible, the final surface of the backup material shall slope away from the surface edge for drainage runoff.

J. Following all paving, all catch basins shall be cleaned. All construction debris shall be removed and disposed of at the Contractor's expense.

3.2 BITUMINOUS CONCRETE BERM

A. Berm installation shall be consistent with the details of the design for 'Modified Type A Bituminous Berm' (Cape Cod Style) and 'Type 2 Bituminous Berm' as shown on the plans.

B. The ends of the existing berm shall be cut with a saw prior to construction of bituminous concrete curb repairs.

C. Prior to the installation of berm, the pavement shall be swept with a power sweeper to remove all trash, sand, dirt, organic matter, and other undesirable material, to the satisfaction of the Engineer. The pavement shall then be prepared with a layer of tack coat to ensure proper adhesion.

D. Construction methods and procedures for bituminous concrete curb shall be in accordance with Section 470 of the Massachusetts Department of Public Works "Standard Specifications for Highways and Bridges," 1988 edition, as amended.

E. Repairs shall be neat in appearance, and shall blend in with the existing adjoining pavement.

F. Protection of the bituminous concrete berm is the Contractor's responsibility. The Engineer shall perform a visual inspection of the berm 3 days after placement. Based on the inspection of berm, portions of berm which do not meet the requirements of the Contract Documents based on appearance, vandalism, workmanship, or for any other aesthetic reason, shall be corrected or removed and replaced at no additional cost to the owner.

END OF SECTION

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SECTION 02775

PORTLAND CEMENT CONCRETE SIDEWALKS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Sidewalks including accessible ramps

B. Related Sections

1. Section 02315 - Excavating, Backfilling, Compaction and Dewatering

2. Section 02320 - Borrow Material

3. Section 03300 – Cast-in-Place Concrete

1.2 REFERENCES

A. ACI 301 (American Concrete Institute) - Specifications for Structural Concrete for Buildings.

B. ACI 304 (American Concrete Institute) - Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete.

C. ASTM A185 - Welded Steel Wire Fabric for Concrete Reinforcement.

D. ASTM A497 - Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

E. ASTM A615 - Deformed and Plain Billet-Steel for Concrete Reinforcement.

F. ASTM C33 - Concrete Aggregates.

G. ASTM C94 - Ready Mix Concrete.

H. ASTM C150 - Portland Cement

I. ASTM C260 - Air-Entraining Admixtures for Concrete.

J. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

K. ASTM C494 - Chemical Admixtures for Concrete.

L. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.

M. ASTM D1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

N. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing, 1986 Edition, as amended.

PART 2 PRODUCTS

2.1 MATERIALS

A. Portland cement concrete shall be an Air-Entrained 4,000 psi, ¾-inch mix in accordance with Section 03300 – Cast-in-Place Concrete.

B. Premolded expansion joint filler shall meet the requirements of AASHTO Designation M153, Type II.

C. Premolded expansion joint filler shall meet the requirements of AASHTO M 213.

D. Gravel borrow for the sidewalk base shall be in accordance with Section 02320 - Borrow Material.

E. Sheet membrane curing compounds shall meet the requirements of ASTM C 309.

PART 3 EXECUTION

3.1 PREPARATION

A. Shape the subgrade parallel to the proposed surface and compact thoroughly. Fill depressions with suitable material and compact again until the surface is smooth and hard.

B. Install a gravel base to a depth of 8 inches on top of the subgrade. Fine grade the gravel base and compact thoroughly with approved mechanical tampers.

C. Place Portland cement panels 4 inches thick for sidewalks in accurately set, smooth wooden or steel forms of sufficient strength to resist springing out of shape. The gravel base shall be fine graded and recompacted immediately ahead of pouring the concrete. Sidewalks shall match the top of the existing adjacent sidewalk panels.

D. Individual concrete sidewalk panels shall be no larger than 30 square feet. Pre-molded expansion joints shall be placed a minimum of every 18 feet.

E. Completely remove mortar and dirt from forms that have been previously used. The forms shall be well staked and thoroughly graded and set to the established lines with their upper edge conforming to the grade of the finished walk. Oil forms before placing concrete.

3.2 INSTALLATION

A. Reinforce the concrete slab with welded wire fabric, 6x6-W4 x W4.

B. Place concrete to half the desired depth at which point the welded wire fabric shall be placed or raised to the surface. The remaining concrete can then be placed. Care should be exercised to avoid walking in areas with reinforcing

C. No finish work shall be performed while free water is present. After water sheen has disappeared and concrete has started to stiffen, edging operations, where required, shall be completed. After edging and joining operations, the surface shall be floated. Immediately following floating, the surface shall be steel-troweled. Following troweling, the concrete sidewalk shall be given a broom finish.

D. Cure the concrete by covering with burlap or other acceptable material that shall be kept moist for at least five (5) days after placing the concrete.

E. Cure the concrete by the application of a liquid membrane-curing compound as soon as free water has disappeared and the surface cannot be marred. The application should be uniform and without puddles.

END OF SECTION

SECTION 02925

SITE RESTORATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Engineered Soil Media
2. Permanent Seeding
3. Plug Plantings
4. Vegetative establishment

1.2 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Engineered Soil Media: Soil material used as surficial material used in the construction of the vegetated islands and swale areas.

C. Finish Grade: Elevation of finished surface of planting soil.

D. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

E. Topsoil: Standardized topsoil; existing, native surface topsoil, existing in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plants.

F. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed

G. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

H. Surface Soil: Soil that is present at the top layer of the existing soil profile, and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile.

1.3 REFERENCES

A. Massachusetts Department of Public Works Standard Specifications for Highways and Bridges (MDPW) 1988, as amended.

B. American Nursery & Landscape Association (ANLA) standards

1.4 SUBMITTALS

A. Seed mixture including percent by weight of each seed and variety, percentage of purity, germination, weed seed, and manufacturer/Supplier name.

B. Plug plantings including common name, botanical name, source, and schedule and procedures for transport and storage prior to installation at the site.

C. Material Test Reports

1. Planting Soil Analysis for existing and imported soils where vegetation is to be established: A standard soil test shall be performed by a licensed commercial testing laboratory or government agency approved by the Engineer. Soil test shall provide recommendation for the addition of fertilizer, lime, and other amendments.

2. Suitable laboratory analysis of the engineered soil media to determine the quantity of fertilizer and lime to be applied.

D. Furnish complete written instructions for maintenance of the plant materials to the Owner at least ten days prior to the end of the maintenance period in order to familiarize the Owner with the proper care and development of the plantings.

1.5 QUALITY ASSURANCE

A. Perform Work with experienced personnel under the direction of a qualified planting supervisor demonstrating a background in landscape operations and whose work has resulted in successful vegetative establishment.

B. Plants are subject to inspection and approval by the Engineer before delivery for conformity to Specification requirements as to quality, size and variety.

1.6 DELIVERY, STORAGE AND HANDLING

A. Only deliver plant materials immediately prior to installation.

B. Deliver plant materials to the Site in accordance with the best horticultural practices to prevent damage.

C. Move and handle plant materials so as to prevent damage to roots and crowns.

D. Protect all plants and products from weather, damage, or other deteriorating conditions.

E. Plug Plantings shall be kept moist during transport to the site and be promptly protected upon arrival at the site.

1. Protection at the site shall provide continuous shade, shelter from the wind, and from drying out by either storage in uncontaminated water or healed in.

2. Plant materials shall be installed within 72 hours of removal from the nursery storage.

F. "Heal-in" plants for protection from sun and wind. Root balls and containers shall be completely covered and kept consistently moist soil until installation.

G. Replace damaged and unhealthy plant materials prior to installation.

H. Bulk Materials

1. Do not dump or store bulk materials near structures, utilities, walkways, or on existing vegetated areas or plants.

2. Provide erosion control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of soil amendments with appropriate certificates.

1.7 SITE CONDITIONS

A. Examination of Conditions

1. All areas to be planted shall be inspected by the Contractor before starting Work and any defects such as incorrect grading, etc., shall be reported to the Engineer prior to beginning this Work. The commencement of Work by the Contractor shall indicate his acceptance of the areas to be planted, and he shall assume full responsibility for the Work of this Section.

PART 2 PRODUCTS

2.1 ENGINEERED SOIL MEDIA

A. Soil material used as surficial material used in the construction of vegetated islands and swale areas.

B. Soils shall be naturally or artificially graded coastal beach material manufactured from compost and other soil constituents for use in establishing wetland vegetation with intertidal coastal wetland areas meeting the following requirements.

1. 60% - 70% sand by volume.

2. 15% - 25% Topsoil or loam by volume

3. 15% - 25% Organic matter by volume

4. 8% maximum silt and clays

2.2 SEED

A. Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to be seeded or planted for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Verify that no foreign or deleterious material or liquid such as paint, pant washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.

2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.

3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.

4. Uniformly moisten excessively dry soil that is not workable or too dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a seeding area, remove the soil and contamination as directed by the Engineer and replace with planting soils.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, and other facilities, trees, shrubs, and plantings from damage caused by seeding and planting operations.

1. Protect grade stakes set by others until directed to remove them.

B. Install erosion control measures to prevent erosion or displacement of soils and discharge of soil bearing water runoff or airborne dust to adjacent properties and walkways.

C. Restore site access routes, staging and storage areas or other areas within the limit of disturbance used by the Contractor during the project by raking, removing disposing of all debris.

3.3 INSTALLATION

A. Engineered Soil Media

1. Spread engineered soil media where shown on the drawings to meet finish grades after light rolling and natural settlement. Do not spread if soil media or subgrade is frozen, muddy, or excessively wet.

2. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3. Restore areas if eroded or otherwise disturbed after final restoration and before seeding or planting.

B. Seeding

1. Sow seed with spreader or seeding machine at rates indicated on the Drawings. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute see by sowing equal quantities in two directions at right angles to each other.

a. Do not use wet seed or seed that is moldy or otherwise damaged.

b. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

2. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

3. Where seeding is not completed within the recommended seeding periods, protection shall be provided on slopes exceeding 6H:1V or otherwise where concentrated runoff flow occurs by erosion control blankets and stapled according to manufacturer's written instructions or by spreading straw mulch.

a. If mulch is used, spread uniformly at minimum rate of 2 tons/acre to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.

b. Anchor mulch by crimping into soil with suitable mechanical equipment.

4. Protect seeded areas with erosion control matting where shown on Drawings; install and anchor according to manufacturer's written instructions.

C. Plug Planting

1. Plug Plantings shall be installed in accordance with the following requirements and as indicated on the Drawings.

    a. Set the plug plantings into the slope soil material. A water jet stinger, probes, driving caps or other staking aids may be used to make a pilot hole in the soil.

3.4 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto road, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period

C. Remove temporary fencing or barricades on vegetated island after plantings are established.

D. Remove any non-degradable erosion control measures after vegetative establishment period.

E. Monitor completed construction immediately following varying flood flows where water levels rise to higher elevations where seed and plug planting vegetation has not yet been completely established through a full growing season, to identify areas of settlement or erosion, and promptly repair/stabilize such areas to protect finished work and support establishment of vegetation with stabilization measures.

END OF SECTION

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SECTION 03100

CONCRETE FORMS AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Wood Form Material
2. Prefabricated Forms
3. Formwork Accessories

B. Related Sections

1. Section 03300 - Cast-in-Place Concrete

1.2 REFERENCES

A. American Concrete Institute (ACI)

1. ACI 301 - Specifications for Structural Concrete for Buildings
2. ACI 318 - Building Code Requirements for Reinforced Concrete
3. ACI 347 - Guide to Formwork for Concrete

B. American Society for Testing and Materials (ASTM)

1. D4 - Standard Test Method for Bitumen Content
2. D6 - Standard Test Method for Loss on Heating of Oil and Asphaltic Compounds
3. D71 - Standard Test Method for Relative Density of Solid Pitch and Asphalt (Displacement Method)
4. D217 - Standard Test Method for Cone Penetration of Lubricating Grease
5. D1056 - Specification for Flexible Cellular Materials - Sponge or Expanded Rubber
6. D1751 - Standard Specifications for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)
7. D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
8. D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial and Agricultural Applications

C. American Association of State Highway and Transportation Officials (AASHTO)

1. AASHTO Standard Specifications for Transportation Materials and Methods of Sampling and Testing

D. National Institute of Standards and Technology (NIST)

1. Voluntary Product Standard PS 1-95 - Construction and Industrial Plywood

1.3 SUBMITTALS

A. Drawings showing schedule of placement, location of all construction joints and all control joints with methods of forming. Show the location and elevation of all sleeves, wall pipes and embedded items.

1.4 DESIGN REQUIREMENTS

A. Design formwork and shoring at the Contractor's expense by a Professional Engineer registered in the State where the work will be performed to conform to all design and code requirements in ACI 301, ACI 318 and ACI 347 and other applicable regulations and codes. The design shall consider any special requirements that may result due to the use of super plasticized and/or retarded set concrete.

PART 2 PRODUCTS

2.1 WOOD FORM MATERIALS

A. Plywood: Class I High Density Overlay plyform, exterior grade, not less than 5 ply nor less than 5/8 inches thick conforming to Voluntary Product Standard PS 1-95

B. Lumber: Douglas Fir species, No. 1 grade S4S with grade stamp clearly visible

2.2 PREFABRICATED FORMS

A. Manufacturers:

1. Symons Corporation, DesPlains, Illinois

2. HICO Corporation, Bronx, NY

3. Or equal

B. Preformed Steel Forms: Minimum 16 gage (1.5 mm), tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearances of finished concrete surfaces; with clean, warp free, undented, ungouged, undamaged surfaces

C. Glass Fiber Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearances of finished concrete surfaces

2.3 FORMWORK ACCESSORIES

A. Form Ties:

1. Ties for foundation walls shall be metal and designed with removable setback cones so that after removal of the projecting part, no metal shall remain within 1½ inches of the face of the concrete.

2. Form ties for tanks, wet wells, pump chambers, below grade structures and other water retaining structures shall have a neoprene waterstop washer placed on each form tie, or on the inside tie rods for systems which use she bolts, and shall have setback cones.

3. Flat bar snap ties for panel forms shall have plastic or rubber inserts with 1½ inch minimum depth to allow patching of tie hole after removal.

4. Setback cones shall be wood or plastic tapered cones 1 inch diameter and 1½ inches deep to allow filling and patching of the concrete surface after removal.

5. Common wire ties shall not be used.

B. Form Release Agent:

1. Non-staining and non-emulsifiable type which will not stain concrete or absorb moisture nor interfere with adherence of any material to be applied to concrete surfaces.

2. Form release agent for potable water tanks and structures shall be vegetable oil based and shall be NSF approved for use with potable water.

C. Corners:

1. Chamfered No. 1 Poplar wood strips; ¾ inch by ¾ inch; maximum possible lengths

D. Dovetail Anchor Slot:

1. Galvanized steel 22 gage thick; non-filled, release tape sealed slots for securing to concrete formwork

E. Flashing Reglets:

1. Galvanized steel 26 gage thick, longest possible lengths, with alignment splines for joints, release tape sealed slots for securing to concrete formwork

F. PVC Waterstops:

1. Virgin polyvinyl chloride, minimum 2000± 50 psi tensile strength, minus 50°F to plus 170°F working temperature range, 9 inches (see designer note above) wide, 3/8 inches thick, factory made corner sections, heat welded jointing; manufactured by Paul Murphy Plastics, Greenstreak, Vinylex or equal

2. Exceed the requirements set forth in the U.S. Army Corps of Engineers waterstop specification (CRD-C572-84)

3. Must exhibit zero water leakage when tested in accordance with the American Concrete Institute (ACI) standard test method for waterstop

4. Heat fused field splices shall be tested for a complete seal by use of a corona discharge unit.

5. Multi-rib design with center bulb shall be used for all expansion joints as noted on Drawings and proposed for the work.

6. Ribbed flat heavy duty design shall be used for all construction joints as noted on Drawings and proposed for the work.

G. Hydrophilic Strip Waterstop:

1. Hydrophilic waterstop shall be Hydrotite as supplied by Greenstreak or equal.

2. The waterstop shall be composed of chloroprene rubber and chloroprene rubber modified to impart hydrophilic properties.

3. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.

4. The hydrophilic waterstop shall have the following performance requirements:

CHLOROPRENE RUBBER

Property	Test Method	Required Limits
Tensile Strength	ASTM D 412	1300 PSI min.
Ultimate Elongation	ASTM D 412	400% min.
Hardness (Shore A)	ASTM D 2240	50 +/- 5
Tear Resistance	ASTM D 624	100 lb/inch min.
Tensile Strength	ASTM D 412	350 PSI min.
Ultimate Elongation	ASTM D 412	600% min.
Hardness (Shore A)	ASTM D 2240	52 +/- 5
Tear Resistance	ASTM D 624	50 lb/inch
Expansion Ratio	Volumetric Change - Distilled Water @ 70° F	3 to 1 min.

5. The hydrophilic waterstop shall be adhered to the concrete surface in accordance with the manufacturer's requirements.

H. Compressible Filler:

1. Closed cell expanded neoprene, ASTM D1056, Grade No. 2C1, ozone and weather resistant

I. Premolded Joint Filler:

1. Buildings and Structures: Self-expanding cork, ASTM D1752, Type III; and Federal Specification HH-F-341-F, Type II, Class C; capable of one directional swelling up to 140% of its original thickness

2. Sidewalks: Asphalt impregnated, ASTM D1751, ¾ inch thick unless otherwise shown on the Drawings

J. Elastomeric Bearing Pads:

1. 60 Durometer neoprene rubber conforming to AASHTO M251

K. Vapor Barrier:

1. 10 mils thick polyethylene sheeting conforming to ASTM D4397

PART 3 EXECUTION

3.1 GENERAL

A. Verify lines, levels and centers before proceeding with formwork. Ensure that dimensions agree with Drawings.

B. Review all work prepared by others to receive work of this Section and correct any defects affecting installation. Commencement of work by the Contractor will be construed as complete acceptance of preparatory work by others.

C. Handle and store materials separately in such manner as to prevent intrusion of foreign matter, segregation, or deterioration. Do not use foreign materials or those containing frozen material. Remove improper and rejected materials immediately from point of use. Cover materials and accessories during construction period.

3.2 VAPOR BARRIER

A. Except where membrane waterproofing is required, all interior concrete slabs-on-grade shall be placed on a continuous vapor barrier.

1. Place 4 inches of fine granular fill over the vapor barrier to act as a blotter for the concrete slab.

2. Vapor barrier joints shall be lapped 6 inches and sealed with compatible waterproof pressure-sensitive tape.

3. Patch all punctures and tears.

3.3 EARTH FORMS

A. Earth forms are not permitted.

3.4 FORM PREPARATION

A. Coat contact surfaces of forms with a form release agent prior to form installation.

B. Thoroughly clean steel forms between uses using high pressure water or jet or sand blasting to remove all mill scale, concrete laitance or other ferrous deposits from the contact surfaces of the forms.

C. Before re-use of wood forms, thoroughly clean form contact surfaces, repair damaged areas and remove projecting nails. A partial or complete steel lining on wood sheathing or plywood will not be allowed.

3.5 ERECTION - FORMWORK

A. Erect formwork, shoring and bracing to achieve design requirements of ACI 301 and the following additional requirements:

1. Variation from plumb in the lines and surfaces of columns, piers, and in walls

a. In any 10 feet of length ¼ inch

b. Maximum for entire length ½ inch

2. Variation of the linear building lines from established position in plan and related positions of columns, walls and partitions:

a. In any bay ¼ inch

b. In any 20 foot of length ¼ inch

c. Maximum for the entire length ½ inch

3. Variation in cross-sectional dimensions of columns and beams and in thickness of slabs and walls:

a. Minus $^{1}/_{8}$ inch

b. Plus ¼ inch

3.6 JOINTS

A. Construction and expansion joints indicated on the Drawings are mandatory and shall not be omitted.

B. Use premolded joint filler at expansion joints unless otherwise noted.

C. Form construction and expansion joints with a keyway and waterstop unless otherwise shown on the Drawings. The depth of the keyway shall be approximately 3 inches, and the minimum width of keyway shall be one-third the width of the wall or floor section unless otherwise shown on the Drawings. The maximum width of any key at a joint with waterstop shall be 3 inches. Construction and expansion joints are to be formed in place prior to notifying the Engineer for inspection of formwork.

D. Where joints other than those shown are required, obtain approval prior to installation.

E. For slab-on-grade construction (welded wire fabric reinforcement only) with large floor areas where construction joints are not shown, the maximum area per section is approximately 600 square feet, but will not limit the number of sections which may be placed at one time. For structural slabs reinforced with deformed bars where construction joints are not shown on the Drawings, the maximum area will be approximately 900 square feet. Slab dimensions between construction joints for floor areas shall be as "square" as possible, but the length shall not exceed 1.5 times the width under any circumstances.

F. For slab-on-grade construction, a preformed metal keyway with removable top strip may be substituted for intermediate construction joints unless otherwise shown on the Drawings.

G. Joints shall be straight and true. Brace all slab bulkheads adequately to keep joints straight. Construction joints in slabs exceeding 5 inches in thickness shall be keyed using a keyway nominally 3-5/8 inches by 1/3 of the slab thickness but not greater than 3 inches wide.

H. Wall construction joints shall be placed as shown on the Drawings, or the maximum spacing of vertical construction joints in walls shall not exceed 40 feet where construction joints are not shown.

I. Joints not indicated or specified shall be placed to least impair strength of structure and shall be subject to approval of the Engineer.

3.7 INSERTS, EMBEDDED ITEMS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in or passing through concrete work in conformance with requirements of ACI 318, paragraph 6.3, “Conduits and pipes embedded in concrete.”

B. Locate and set in place items that will be cast directly into concrete.

C. Coordinate work of other Sections in forming and placing openings, slots, reglets, recesses, chases, sleeves, wall pipes, anchor bolts and other inserts.

D. Install accessories in accordance with manufacturer's instructions, straight, level and plumb. Ensure items are not disturbed or damaged during placement of concrete.

E. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at the bottom of forms to allow flushing water to drain.

F. Close temporary openings with tight fitting panels, flush with inside face of forms and neatly fitted so that joints will not be apparent in exposed concrete surfaces after concrete placement.

3.8 WATERSTOPS

A. Install PVC waterstops in all construction and expansion joints in walls and slabs unless otherwise noted on the Drawings. Position waterstop in the center of the joint and extend the entire length of the joint. Securely fasten waterstop to reinforcing steel or formwork on both sides at 12 inch maximum spacing. Provide 2 inch minimum clearance between waterstop and reinforcing steel.

B. Heat and splice PVC waterstop with a thermal splicing unit designed for that specific purpose. Only properly mitered, straight butt splices shall be made in the field. All field splices shall be tested for a complete seal by use of a corona discharge unit.

C. No holes will be permitted in the PVC waterstop. Nail holes or other penetrations in the waterstop shall be repaired prior to placement of concrete.

D. Hydrophilic waterstop shall be installed in accordance with the manufacturer's recommendations.

E. The Engineer shall approve of the proposed location, concrete cover and steel reinforcement prior to the installation of any Hydrophilic waterstop.

F. The Hydrophilic waterstop ends shall be cut square or mitered at corners. In addition, all waterstop splices shall be sealed in accordance with the manufacturer's requirements.

3.9 ACCESSORIES

A. Install form liners into formwork prior to placement of reinforcing steel or concrete in compliance with the manufacturer's requirements.

B. Neoprene waterstop washers are to be placed along the form ties or inside ties so they are in the middle third of the thickness of the structural element.

C. Position metal fabrications accessories and inserts supplied under Sections 05120 and 05500 as specified therein and shown on the Drawings.

3.10 FORM REMOVAL

A. The Contractor shall be responsible for damage resulting from form removal. Forms and shoring for structural slabs or beams shall remain in place in accordance with requirements in ACI 301. Form removal shall also conform to the requirements specified in Section 03300.

3.11 INSPECTION

A. The Engineer shall be notified when the forms are complete and ready for inspection at least thirty-six hours prior to the proposed concrete placement.

B. Failure of the forms to comply with the requirements specified herein, or to produce concrete complying with requirements of these Specifications, shall be grounds for rejection of that portion of the concrete work. Rejected work shall be repaired or replaced at no additional cost to the Owner. Such repair or replacement shall be subject to the requirements of these Specifications and approval of the Engineer.

END OF SECTION

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SECTION 03200

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Reinforcing Steel Bars
2. Welded Wire Fabric
3. Reinforcing Accessories

B. Related Sections

1. Section 03100 - Concrete Forms and Accessories
2. Section 03300 - Cast-in-Place Concrete

1.2 REFERENCES

A. The Massachusetts State Building Code, latest edition.

B. American Concrete Institute (ACI)

1. ACI 117 - Standard Tolerance for Concrete Construction and Materials
2. ACI 301 - Specifications for Structural Concrete for Buildings
3. ACI 315 - Details and Detailing of Concrete Reinforcement
4. ACI 318 - Building Code Requirements for Reinforced Concrete, American Concrete Institute
5. ACI 350R - Environmental Engineering Concrete Structures
6. ACI SP-66 - Detailing Manual

C. American Society for Testing and Materials (ASTM)

1. A185 - Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
2. A615 - Specification for Deformed and Plain Billet - Steel Bars for Concrete Reinforcement
3. A675 - Specifications for Steel Bars, Carbon, Hot Wrought, Special Quality, Mechanical Properties

D. American Welding Society (AWS)

1. D1.4 Structural Welding Code - Reinforcing Steel

E. Concrete Reinforcing Steel Institute (CRSI)

1. CRSI 63 - Recommended Practice for Placing Reinforcing Bars

2. CRSI 65 - Recommended Practice for Placing Bar Supports, specifications and nomenclature

1.3 SUBMITTALS

A. Provide shop drawings in accordance with the recommendations of ACI 315, "Details and Detailing of Concrete Reinforcement" and show the following: elevations, dimensions of concrete work with specified reinforcement clearances; ledges, brackets, openings, sleeves or other items furnished by other Sections, where interference with reinforcement may occur; bending diagrams; assembly diagrams; splices and laps of reinforcement; temperature and shrinkage reinforcement; construction joint reinforcement and shape; dimensions, grade designations, and details of reinforcement and accessories. Show dowels with concrete work to be placed first. Shop drawings shall be drawn to scale.

B. Bar Bending Details - The bars shall be referenced to the same identification marks shown on the placement drawings. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified.

C. Prior to delivery of reinforcing steel or concrete to job site, submit certified mill test reports of reinforcing steel and cement (including names and locations of mills and shops, and analyses of chemical and physical properties), properly correlated to concrete to be used in this project.

1.4 DELIVERY, HANDLING AND STORAGE

A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.

B. Reinforcing steel shall be covered and stored off the ground, protected from moisture, and kept free from dirt, oil, or other foreign matter.

PART 2 PRODUCTS

2.1 REINFORCING STEEL BARS

A. Reinforcing steel bars shall be newly rolled billet steel conforming to ASTM A615, Grade 60.

B. Minimum yield strength shall be 60,000 psi.

C. Where reinforcing steel bars are called for to be grouted into existing concrete, the anchorage shall develop an allowable bond strength equal to 24,000 psi times the cross section area of the bar, or an ultimate strength equal to the tensile strength of the bar.

1. For installations in non-submerged concrete with an ambient temperature greater than or equal to 40 degrees Fahrenheit, the epoxy adhesive shall be, Hilti HIT_HY 200, Simpson SET-XP, Powers PE 1000+ or approved equal.

2. For installation in wet or submerged concrete with an ambient temperature greater than or equal to 40 degrees Fahrenheit, the epoxy adhesive shall be Hilti HIT RE-500SD, Simpson ET-HP, Powers Pure 110+ or approved equal.

3. For installation in concrete below 45 degrees Fahrenheit the epoxy adhesive shall be Hilti HIT ICE, Simpson AT-XP or equal.

2.2 WELDED WIRE FABRIC

A. Welded wire fabric shall conform to ASTM A185

2.3 REINFORCEMENT ACCESSORIES

A. Reinforcement accessories shall conform to Product Standard PS7-766, National Bureau of Standards, Department of commerce, Class C, as produced by Dayton Superior Corporation; R.K.L. Building Specialties Co., Inc. or equal approved by the Engineer.

B. Reinforcement accessories shall include spacers, chair ties, slab bolsters, clips, chair bars, and other devices for properly assembling, placing, spacing, supporting, and fastening reinforcement.

C. Tie wire shall be of sufficient strength for all intended purpose, but not less than No. 18 gauge. Metal supports shall be of such type as not to penetrate surface of formwork and show through surface of concrete.

D. Accessories touching interior formed surfaces exposed to view shall have not less than 1/8 inch of plastic between metal and concrete surface. Plastic tips shall extend not less than 1/2 inch up on metal legs.

E. Individual and continuous slab bolsters and chairs shall be of type to suit various conditions encountered and must be capable of supporting 300 pound load without damage or permanent distortion.

F. Expansion Joint Dowels

1. Dowels shall conform to ASTM A675.

2. Expansion dowel caps shall be No. 87 dowel caps as manufactured by Heck Building Products, Inc., Type F-46 dowel caps as manufactured by the Dayton Sure-Grip and Shore Company, or equal.

PART 3 EXECUTION

3.1 EXAMINATION

A. Review all work prepared by others to receive work of this Section. Commencement of work will be construed as complete acceptance of preparatory work by others.

3.2 PREPARATION

A. Notify the Engineer prior to the start of any phase of the reinforcing work so as to provide the opportunity to inspect the work. Such notification shall be made at least 24 hours in advance of reinforcement placements and at least 36 hours in advance of other inspections (forms, etc.).

3.3 REINFORCING BAR FABRICATION

A. Fabrication of reinforcement shall be in accordance with the recommendations of CRSI.

B. Reinforcing bars shall be cold bent and shall not be straightened or re-bent. Bars shall not be field bent unless approved by the Engineer.

C. Reinforcing bars shall be bent around a revolving collar having a diameter of not less than that recommended by the CRSI.

D. Reinforcing bar ends that are to be butt spliced or threaded, shall have the applicable end saw-cut. Such ends shall terminate in flat surfaces at a right angle to the axis of the bar.

E. Where reinforcing bars are called for to be welded, the welding shall conform to AWS D1.4 Structural Welding Code - Reinforcing Steel.

3.4 INSTALLATION

A. Reinforcement shall be placed in accordance with requirements of CRSI -63 - "Recommended Practice for Placing Reinforcing Bars" and CRSI 65, "Recommended Practice for Placing Bar Supports" and with further requirements below.

B. Reinforcement shall be accurately placed in accordance with Contract Documents and shall be firmly secured in position by wire ties, chairs, spacers, and hangers, each of type approved by the Engineer. For slabs, grade beams, etc. where concrete is poured on grade, use additional setup bars and concrete brick to provide required cover over reinforcement.

C. Bending, welding or cutting reinforcement in field in any manner other than as shown on Drawings, is prohibited, unless specific approval for each case is given by the Engineer.

D. Reinforcement shall be continuous through construction joints unless otherwise indicated on Drawings.

E. Reinforcement shall be spliced only in accordance with requirements of Contract Documents or as otherwise specifically approved. Splices of reinforcement at points of maximum stress shall generally be avoided.

F. Welded wire fabric shall lap 6 inches or one space plus 2 inches whichever is larger, and shall be wired together. Provide No. 4 set up bars spaced 30 inches on center for slabs-on-grade or elevated slabs with composite decks.

G. Proceed with installation of embedded items, and reinforcement, but do not place concrete into or around such items until the Engineer has approved work.

3.5 FIELD QUALITY CONTROL

A. The Engineer shall have the right to postpone or stop concrete operations when in his judgment, reinforcement and embedded item installation has not been properly completed or the quality of construction will impair strength and durability or desired finished product. Costs arising from delays due to noncompliance will not be considered.

B. Any material or workmanship that is rejected, either at the batch plant or at the site, shall be replaced promptly at no additional cost to the Owner.

C. Before concrete is placed, reinforcement shall be free of excessive rust, dirt, oil, scale or other foreign matter that will destroy or reduce bond requirements. Reinforcement expected to be exposed to weather for a considerable length of time shall be painted with a heavy coat of cement grout. Protect stored materials so as not to bend or distort bars in any way. Bars that become damaged will be rejected.

D. Before concrete is placed, check all installed reinforcement to ensure that it conforms to Contract Documents and approved Shop Drawings. Such checking shall be done only by qualified experienced personnel. In addition, the Engineer shall be notified at least 36 hours prior to concrete placement and given opportunity to inspect completed reinforcement. Prior approval of Shop Drawings shall in no way limit the Engineer's right to require modifications or additions to reinforcement or accessories.

E. Expansion joint dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04 inches on the diameter of the dowel and extends no more than 0.04 inches from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end.

3.6 ADJUSTING

A. Carry out corrections without delay as directed by the Engineer when construction operations indicate that requirements of Contract Documents or prudent construction practices are being or are about to be violated.

END OF SECTION

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SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Concrete Materials
2. Admixtures
3. Concrete Mix
4. Miscellaneous Concrete Materials

B. RELATED SECTIONS

1. Section 03100 - Concrete Forms and Accessories

1.2 REFERENCES

A. The Massachusetts State Building Code, latest edition

B. American Concrete Institute (ACI)

1. ACI 301-95 - Specifications for Structural Concrete for Buildings, (included as part of this specification)
2. ACI 305 - Hot Weather Concreting
3. ACI 306.1-90 - Standard Specifications for Cold Weather Concreting
4. ACI 318-15 - Building Code Requirements for Reinforced Concrete", American Concrete Institute

C. American Society for Testing and Materials (ASTM)

1. C33 – Standard Specification for Concrete Aggregates
2. C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
3. C40 - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete
4. C42 – Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
5. C87 - Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar
6. C94 - Standard Specification for Ready-Mixed Concrete
7. C131 - Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
8. C150 – Standard Specification for Portland Cement

9. C260 - Standard Specification for Air-Entraining Admixtures for Concrete

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

11. C494 - Standard Specification for Chemical Admixtures for Concrete

12. C535 - Standard Test Method for Resistance to Degradation of Large-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

13. C618 – Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete

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

15. C881 – Standard Specification for Epoxy-Resin Base Bonding Systems for Concrete

16. C989 – Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars

17. C1059 – Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete

1.3 SUBMITTALS

A. Submit concrete mix proposed for use, indicating design strength, supplier, batch quantities, and constituents. Provide test report copies indicating prior satisfactory performance in accordance with ACI 301.

B. Submit data and descriptive literature for concrete constituents including admixtures, aggregate tests, bond breaker, bonding agent, and repair grout.

C. Submit detailed methods proposed for curing and protection of concrete. This submittal shall be made not less than 10 days prior to the placement of any concrete.

D. Submit a truck load ticket for every concrete delivery. Ticket information shall include batch time and date, weights of all constituents, quantity of admixtures, water added at the batch plant and moisture content of coarse and fine aggregates.

E. Maintain an accurate daily record of the locations and quantity of concrete placed.

1.4 QUALITY ASSURANCE

A. Provide inspection of cast-in-place concrete work, and testing, including slump tests, air content, and standard compression testing. Materials and workmanship shall be subjected to inspection and testing in mill, shop and/or field by the Engineer. Such inspection and testing shall not relieve Contractor of his responsibility to provide his own inspection, testing, and quality control as necessary to furnish materials and workmanship in accordance with requirements of this Section.

B. Provide notification prior to the start of any phase of concrete placement work so as to provide the opportunity to inspect the work. Such notification shall be made at least 24 hours in advance of concrete placements and at least 36 hours in advance of other inspections (forms, rebar, etc.).

C. Facilitate observation by the Engineer as well as inspection and testing by the concrete testing agency, and furnish the following:

1. Safe access to the work at all times to allow proper inspection of the work

2. Full and ample means and assistance for sampling and testing materials and proper facilities for inspection of work in plant and at project site

3. Covered box large enough to contain twenty-four standard concrete cylinders. At temperatures below 60°F, box shall be electrically heated and thermostatically controlled to maintain inside temperature of 60º to 80°F. Cylinders shall be placed in box immediately after molding and shall be covered with moist burlap until delivery to laboratory, 24 to 72 hours after molding.

4. Access by the Engineer or his representative to the batch plant supplying the concrete at any time.

D. Compression tests shall consist of one set of 4 cylinders for each test made, cured, and tested by testing laboratories during progress of job. 6 cylinders shall be required for each test made with concrete mix containing fly ash or ground granulated blast furnace slag. One set of cylinders shall be taken for every 100 cubic yards of concrete or fraction thereof placed in any one day.

1. 1 cylinder of each set shall be tested for 7-day compressive strength; 2 cylinders shall be tested for 28-day compressive strength. The remaining cylinder shall be tested for 56-day compressive strength if either one of the 28-day tests are below the specified strength, otherwise the 56-day test will be eliminated.

2. For modified mix with fly ash or ground granulated blast furnace slag, 1 cylinder of each set shall be tested for 7-day compressive strength, 2 cylinders shall be tested for 28-day compressive strength and 2 cylinders shall be tested for 56-days compressive strength. The remaining cylinder shall be tested for 84-day compressive strength if either one of the 56-day tests are below the specified strength, otherwise the 84-day test will be eliminated.

3. The Owner will provide and pay for the services of an approved testing laboratory to test the cylinders. The Contractor shall coordinate and schedule all concrete testing performed by approved agency.

4. Compression strength test of cylinders shall conform to ASTM C39, latest revision. The testing laboratory will submit certified copies of the test results directly to the Engineer and the Owner within 24 hours after tests are made.

5. Sampling, molding, curing and testing of cylinders shall conform to ASTM requirements. Specimens shall be cured under laboratory conditions. The Engineer may require additional cylinders to be cured under field conditions when unusual conditions may tend to reduce concrete strength.

6. Report of tests shall include: name of project, date and location of concrete placement, design strength of concrete, mix data, slump, air content (if tested), compressive strength, age and condition of test cylinder, type of fracture, and type of curing.

E. Slump test, to check consistency, shall be made from the sample used to mold cylinders. Additional slump tests may be taken of every batch delivered to job site.

F. Tests for determination of air content shall be made as required to verify conformance with the specifications.

G. The strength level of the concrete mix shall be considered satisfactory if both of the following criteria are satisfied:

1. Every arithmetic average of any three consecutive strength tests equals or exceeds the specified design strength.

2. No individual strength test (average of two cylinders from the same test group) falls below the specified design strength by more than 500 psi when the specified design strength is 5000 psi or less or by more that 10 percent of the specified design strength when the design strength is more than 5000 psi.

H. When tests of control specimens fall below these requirements, the Engineer will require 56 day or 84 day cylinder tests or core specimens taken from concrete in question and tested in accordance with ASTM C42. If these specimens do not meet strength requirements, the Engineer has the right to require additional curing, load tests, strengthening or removal and replacement of those parts of the structure which are unacceptable, and in addition, removal of such sound portions of structure as necessary to ensure safety, appearance, and durability of structure. Additional testing, load tests, strengthening or removal and replacement of parts or structure and any costs associated with delay of project shall be at no additional cost to the Owner.

I. Any material or workmanship which is rejected, either at the batch plant or at the site, shall be replaced promptly at no additional cost to the Owner.

J. If arrangements for corrections and/or replacements are not made within seven days after notice of rejection, the Owner has the right to have corrections and/or replacement made and charge cost thereof and any costs associated with delay of project against balance of monies withheld.

K. Acceptance of work and admixtures at the batch plant shall not prevent final rejection at job site upon arrival or after it has been installed, if work is found to be defective.

L. Portions of a structure which do not meet the requirements of the Contract Documents based on appearance or for any other aesthetic reason, shall be corrected or removed and replaced at no additional cost to the Owner.

M. Work on new concrete structures shall conform to the requirements of ACI 306.1, Standard Specifications for Cold Weather Concreting, except as modified herein.

PART 2 PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: shall be American-made Portland Cement, free from water soluble salts or alkalies which will cause efflorescence on exposed surfaces. Portland Cement shall be Type II, ASTM C150. Air entraining cements are prohibited.

B. Pozzolans and Blast Furnace Slag

1. Fly Ash: Class F conforming to the requirements of ASTM C618.

2. Ground Granulated Iron Blast-Furnace Slag: Conforming to ASTM C989.

C. Normal weight Fine Aggregate

1. Washed, inert, natural sand conforming to ASTM C33 and the following additional requirements.

a. Fineness Modulus 2.75 (plus/minus 0.25)

b. Clay lumps and friable particles – 3.0 percent maximum

c. Coal and lignite – 0.5 percent maximum

d. Organic Impurities (ASTM C40) – Organic Plate No. 2

e. Strength of Mortar (ASTM C87) – not less than 95 percent at 7 days

f. Soundness (AASHTO T-104) - 10 percent maximum loss (magnesium sulfate solution, five cycles)

D. Normal weight Coarse Aggregate

1. Well graded crushed stone or washed gravel conforming to ASTM C33 and the following additional requirements:

a. Material finer than No. 200 sieve – 1.0 percent maximum

b. Clay lumps and friable particles – 2.0 percent maximum

c. Chert (less than 2.40 specific gravity, saturated surface dry) – 3.0 percent maximum by weight.

d. Sum of clay lumps, friable particles, and chert (less than 2.40 specific gravity, saturated surface dry) – 3.0 percent maximum by weight. This limitation only applies to aggregates in which chert appears as an impurity.

e. Coal and lignite – 0.5 percent maximum

f. Soundness - 18 percent maximum loss (magnesium sulfate solution, five cycles)

g. Soundness - 10 percent maximum loss (sodium sulfate solution, five cycles)

2. Coarse aggregates shall not exceed 35% by weight "percentage of wear" as determined by the Los Angeles Abrasion and Impact Tests in ASTM C131 and C535.

E. Water shall be from approved source, potable, clean and free from oils, acids, alkali, organic matter and other deleterious material.

2.2 ADMIXTURES

A. Water-reducing agent:

1. Water-reducing agent shall be by same manufacturer as air-entraining agent.

2. Daracem - 55 W.R. Grace & Co.

3. Pozzolith 220N – BASF Admixtures, Inc.

4. Eucon MR - Euclid Chemical Co.

5. Or equal conforming to ASTM C494 Type A.

B. Air-entraining agent:

1. DAREX AEA - W.R. Grace & Co.

2. MB-VR or MB-AE90 - BASF Admixtures, Inc.

3. Air-Mix - Euclid Chemical Co.

4. Or equal conforming to ASTM C260.

C. Admixtures which retard setting of cement in concrete shall not be used without written approval of the Engineer. Admixtures causing accelerated setting of cement in concrete shall not be used.

2.3 CONCRETE MIX

A. Select proportions of ingredients to meet the design strength and materials limits specified and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportioning shall also conform to the requirements in ACI 301 and ACI 318.

B. The concrete mix design shall be a 4000 psi compressive strength concrete using ¾ inch aggregate. The design mix shall be selected based on previous test records for a mix with essentially the same proportions, and shall meet the following limiting values in Table A:

TABLE A
Maximum Allowable Water/Cement Ratios

Minimum Allowable 28 day Compressive Strength (psi)	Maximum Allowable Water/Cement Ratio	Total Cementitious Material (Pounds)	
		Min	Max
4000	0.45	611	635

C. If sufficient test records are not available, (at least 30 consecutive strength tests or two groups of tests totaling at least 30 within the past 12 months), the design mix shall be developed using laboratory trial mixtures in accordance with ACI 301.

D. All concrete is normal weight with air-dry weight not to exceed 150 lbs. per cubic foot.

E. Fly ash may be substituted for up to 20 percent by weight of the total cementitious material. Ground granulated iron blast-furnace slag may be substituted for up to 40 percent by weight of the total cementitious material.

F. For concrete flatwork with a steel trowel finish, fly ash may be substituted for up to 10 percent by weight and ground granulated iron blast-furnace slag may be substituted for up to 25 percent by weight of the total cementitious material.

G. All concrete shall contain the approved air-entraining admixture as per manufacturer's written instructions to provide entrained air by volume in the cured concrete between 4.5 and 7.5%.

H. The design mix shall meet the following slump limiting values in Table B:

TABLE B
Concrete Slump[1]

Portion of Structure	Recommended (inches)	Maximum Range (inches)
Mats	2	2-3
Walls, Column, Beams	4	3-5
Slabs	3	2-4

[1]After addition of high range water reducer

I. The approved water-reducing admixture shall be used in all concrete, in accordance with manufacturer's written instructions.

2.4 MISCELLANEOUS MATERIALS

A. Grout shall be a ready-to-use, non-metallic, non-shrink aggregate product requiring only the addition of water at the job site. Grout shall be as manufactured by Five Star Products, Inc.; Euclid Chemical Company; Master Builders; or equal. Grout shall be easily workable and shall have no drying shrinkage at any age. Compressive strength of grout (2 inch by 2 inch cubes) shall not be less than 5000 psi at 7 days, and 7500 psi at 28 days.

B. Floor Hardener, Sealer, and Waterproofing Treatment:

1. Concrete floor surfaces not covered with resilient flooring or carpet shall receive a surface treatment after steel trowel finishing.

2. Product and Manufacturer:

a. Ashford Formula hardener and sealer as manufactured by Concrete Chemical Company, Inc., Springville, Utah

b. Seal Hard concrete sealer as manufactured by L&M Construction Chemicals, Inc., Omaha, Nebraska

c. Approved equal

C. Concrete Construction Joint Roughener:

1. Provide a water soluble non-flammable, surface-retardant roughener.

2. Product and Manufacturer:

a. Rugasol-S by Sika Corporation for horizontal joints only

b. MasterFinish QD 200 by BASF Corporation for vertical joints

c. Approval equal

D. Bond Breaker:

1. Provide an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.

2. Bond breaker for concrete other than where tape is specifically called for shall be either bond breaker tape or an ASTM C309 non-staining type bond prevention coating such as Masterkure 100WB by Degussa Construction Chemicals, Dayton Superior Sure Lift J6WB, StarSeal Clean Lift by Vexcon Chemicals or equal.

E. Bonding Agent:

1. Provide a two-component, 100% solids, moisture –tolerant structural epoxy adhesive conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, NJ, Concresive Liquid (LPL) by Degussa Admixtures, Inc. of Cleveland, OH or equal.

2. Latex bonding agent shall be a non-remulsifiable acrylic-polymer latex conforming to ASTM C1059 Type II.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify cover requirements over all reinforcement.

B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

C. Verify site conditions to ensure that full access is available for placement of concrete.

3.2 JOINTS

A. Construction and expansion joints indicated on Drawings are mandatory and shall not be omitted. Construction joints shall conform to the requirements of Section 03100 and the following:

1. Before placing new concrete against concrete already in place and hardened, the surface shall again be cleaned with a jet where practical. The exposed aggregate shall then be mopped with a mortar composed of the same proportions of sand and placed and mopped in place immediately prior to the placing of concrete and shall not have set up or hardened prior to the placing of concrete.

2. Where joints other than those shown are required, they shall be made at such locations as the Engineer may allow, and shall in no case impair the structural strength of the structure.

B. Joints not indicated or specified shall be placed to least impair strength of structure and shall be subject to approval of the Engineer.

C. Saw-cut joints shall be installed in the locations shown on the Drawings. Saw-cut joints shall not be substituted for formed construction joints unless approved by the Engineer. Saw-cut joints shall conform to the following requirements:

1. The depth of the saw cut shall be at least ¼ of the slab thickness or a minimum depth of one inch unless otherwise shown on the Drawings.

2. Do not saw cut through slab reinforcing steel unless directed to do so in writing by the Engineer.

3. Joints produced using conventional wet-cut process shall be completed within 4 to 12 hours after the slab has been finished - 4 hours in hot weather conditions and 12 hours in cold weather conditions.

4. Joints produced using the early-entry dry cut process shall be formed using diamond-impregnated blades and shall be completed within 1 to 4 hours after the slab has been finished – 1 hour in hot weather conditions and 4 hours in cold weather conditions. The maximum depth of joints produced by the dry cut process shall not exceed 1-1/4 inches. Care should be taken to make sure that the saw does not ride up over large or hard coarse aggregates.

5. Regardless of the saw cutting process chosen, the saw cutting must be performed before the concrete starts to cool, as soon as the concrete surface is firm enough not to be torn or damaged by the cutting blade, and before random-drying-shrinkage cracks can form in the concrete slab.

3.3 MIXING, CONSISTENCY, AND DELIVERY OF CONCRETE

A. Concrete shall be ready-mixed, produced by a central batch plant. Hand or site mixing shall not be allowed. Constituents, including admixtures, shall be batched at the central batch plant. Admixtures shall be premixed in solution form and dispensed as recommended by the manufacturer.

B. Central plant and rolling stock equipment and methods shall conform to Truck Mixer and Agitator Standard of Truck Mixer Manufacturer's National Ready-Mixed Concrete Association, ASTM C94, ASTM C685, and Contract Documents. Consistency of concrete at time of placement shall be at a 3 inch slump, +/- 1 inch.

C. Ready mixed concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of rated capacities. Discharge at site shall be within one and one-half hours after cement is first introduced into the aggregates. Concrete with a temperature greater than 90°F. shall be rejected and removed from the site.

D. During any of the following conditions: high ambient temperature, high concrete temperature, low relative humidity, increased wind velocity, high solar radiation, when the temperature of the concrete is 85°F or above, the time between the introduction of cement to the aggregates and discharge shall not exceed one hour. In addition, when the rate of evaporation on the surface of the concrete is expected to approach 0.2 $lb/ft^2/hr$. (see chart in ACI 305R) special precautions shall be taken against the formation of plastic shrinkage cracking on the surface of the concrete after placement.

E. During any period when for more than three successive days the average daily outdoor temperature drops below 40°F, the concrete temperature at the time of placement shall be as specified in Table C below.

TABLE C
Concrete Temperature During Cold Weather

Least dimension of section, inches.	**Minimum temperature of concrete as placed and maintained during the protection period, °F**	**Maximum gradual decrease in surface temperature during any 24 hours after end of protection, °F**
Less than 12	55	50
12 to less than 36	50	40

36 to 72	45	30
Greater than 72	40	20

F. Central mixed concrete shall be plant mixed a minimum of five minutes. Agitation shall begin immediately after premixed concrete is placed in truck and shall continue without interruption until discharged. Transit mixed concrete shall be mixed at mixing speed for at least ten minutes immediately after charging truck followed by agitation without interruption until discharged.

G. Retempering of concrete which has partially hardened by mixing with or without additional cement, aggregates, or water shall not be permitted.

3.4 PLACING CONCRETE

A. Remove excess water and foreign matter from forms and excavations. Do not place concrete on frozen soil. Provide adequate protection against frost action during freezing weather.

B. Transport concrete from mixer to place of final deposit as rapidly as practical by methods which prevent separation of ingredients and displacement of reinforcements, and which avoid re-handling. Do not deposit partially hardened concrete. When concrete is conveyed by chutes, equipment shall be of such size and shape to ensure continuous flow in chute. Flat (coal) chutes shall not be used. Chutes shall be of metal or metal lined and uniformly sloped. Slope shall not be less than 25° nor more than 45° from horizontal. Concrete shall be lowered and maintained as near to the surface of deposit as practicable. The chute shall be thoroughly cleaned before and after each use and debris and any water shall be discharged outside of the forms. Concrete shall not be allowed to flow horizontally over distances exceeding 10 feet or dropped vertically over 6 feet.

C. Place concrete in such a manner as to prevent segregation and accumulations of hardened concrete on forms or reinforcement above the grade of concrete being placed. Suitable hoppers and spouts with restricted outlets and tremies shall be used as required.

D. Thoroughly consolidate each layer of concrete by rodding and vibrating using internal type mechanical vibrator. Vibration shall be done by experienced operators under close supervision and shall be carried on only enough to produce homogeneity and optimum consolidation without permitting segregation of constituents or "pumping" of air. Vibrators used for normal weight concrete shall operate at speeds of not less than 7,000 vpm and be of suitable capacity. Do not use vibrators to move concrete. Vibration shall be supplemented by spading to remove bubbles and honeycombs adjacent to visible surfaces. At least one vibrator shall be on hand for every 10 cubic yards of concrete placed per hour, plus one spare. Vibrators shall be operable and on site prior to starting concrete placement.

E. Deposit concrete continuously, and in layers of such thickness that no concrete will be deposited on concrete which has hardened sufficiently to cause formation of seams and planes of weakness within the section. If a section cannot be placed continuously between planned construction joints, as specified, field joints and additional reinforcement shall be introduced at the Contractor's expense to preserve structural continuity.

F. Cold joints, particularly in exposed concrete, including "honeycombs", are unacceptable. If they occur in concrete surfaces exposed to view, the Engineer will

require that entire section in which blemish occurs be removed and replaced with new materials at the Contractor's expense.

3.5 CURING AND PROTECTION

A. When concrete is placed at or below an ambient air temperature of 40°F. or whenever this temperature or lower values are likely to occur within 48 hours after placement of concrete, cold weather concreting procedures, according to ACI 306.1 and as specified herein, shall be followed. The entire area affected shall be protected by adequate housing or covering, and heating. No salt, chemicals or other foreign materials shall be used in the mix to lower the freezing point of concrete. No oil or kerosene heaters shall be utilized. Vent flue gases from combustion heating units to the outside of the enclosure.

B. No frozen materials shall be used in batching concrete and any ice shall be removed from coming into contact with the concrete.

C. Protect concrete work against injury from heat, cold, and defacement of any nature during construction operations.

D. Concrete shall be treated and protected immediately after concreting or cement finishing is completed, to provide continuous moist curing above 50°F. for at least 7 days, regardless of ambient air temperatures.

E. All concrete shall be cured immediately after finishing in accordance with the following requirements:

1. Curing shall be accomplished by a continuous soaking process such as the use of soaker hose or sprinklers, or by use of plastic roll materials to cover the concrete, which shall be thoroughly wetted at least once a day or more often as required in very hot weather. Such plastic shall be placed as soon as possible after finishing of concrete so that scarring of the surface will not occur. Plastic shall be held in place on the surface of the concrete in such a manner and means as will not allow it to be blown off or otherwise dislodged from the concrete surface. Curing procedures shall be maintained continuously for a period of at least 7 days.

2. All methods of curing shall be subject to approval of the Engineer, and each method employed shall be practical and adequate for the curing required. Curing compounds in lieu of wet curing will not be allowed.

F. Keep permanent temperature records showing date and outside temperature during concreting operations. Thermometer readings shall be taken at start of work in morning, at noon, and again late in afternoon. Locations of concrete placed during such periods shall likewise be recorded in such manner as to show any effect temperatures may have had on construction.

3.6 REMOVAL OF FORMWORK

A. Forms shall not be removed until concrete has attained sufficient strength to support its own weight, construction loads to be placed thereon and lateral loads, without damage to structure or excessive deflection.

B. With the exception of construction joint bulkheads and keyways, forms and supports shall remain in place for not less than the minimum time periods noted below.

1. Unless specifically authorized by the Engineer, forms for vertical surfaces shall not be removed before the concrete has attained a strength of not less than 30

percent of the minimum allowable prescribed compressive strength nor not less than the minimum time period specified in Table D.

2. Unless specifically authorized by the Engineer, forms for horizontal surfaces shall not be removed before the concrete has attained a strength of not less than 60 percent of the minimum allowable prescribed compressive strength nor not less than the minimum time period specified in Table D.

TABLE D
Minimum Degree Day Requirement for Form Removal

Form Use	Degree-Days
Walls and Vertical Surfaces	200
Elevated Slabs	400
Beams and Girders	600

3. Definition of degree-days - Total number of days times mean daily air temperature at the surface of the concrete. For example, 5 days at temperature of 60°F. equals 300 degree-days. Days or fractions of days in which temperature is below 50°F. shall not be included in calculation of degree-days except where modified by Table C above.

C. Forms for construction joint bulkheads and keyways may be removed the following day, after the concrete pour. Extreme caution must be used to avoid damage to the concrete surface and keyway.

D. Any test cylinders required to verify the specified minimum strengths for form removal shall be field cured under the same conditions as the concrete they represent. Such cylinders and testing shall be at the Contractor's expense.

3.7 FINISHING OF CAST-IN-PLACE CONCRETE

A. Upper Horizontal Surfaces

1. Horizontal surfaces not subjected to wear, such as tops of parapets, copings, walls, etc., shall be formed by placing an excess of material in the forms and removing or striking off such excess with a template, forcing the coarse aggregate below the surface of the mortar.

2. Horizontal surfaces shall be attained by striking off excess concrete and in no case shall concrete be added to the tops of walls, etc., once initial set has taken place.

3. The top of such surfaces shall be finished in a manner as required and dictated by the necessary appearance of the part being finished. For covered surfaces, a wood float finish will in most cases be sufficient. Steel troweling may be necessary where concrete is exposed to view and adjacent surfaces have a steel trowel finish. In other cases, a "broom" finish may be required.

B. Slab Surfaces

1. Interior traffic bearing surfaces shall have a steel trowel finish and exterior slabs shall have a wood or magnesium trowel non-slip finish. The finish shall be accomplished by a procedure as follows, but shall be the Contractor's responsibility to produce a good and proper finish on all parts of the work:

a. "Steel Trowel Finish" - The surface shall be screeded and given a minimum of two trowelings using a steel trowel. The final troweling shall be done at a time when the concrete has set to a point where troweling produces a ringing sound as the trowel is drawn across the surface. Where surface areas are large enough to permit their use, power finishing machines will be used. For all steel trowel finishes, a fine textured dense surface shall be the final result. Premature finishing will require additional troweling to obtain the final result.

b. "Wood Float Finish" - The surface shall be screeded, given a minimum of one steel troweling and shall then be finished with a wood, cork or other float as required to produce the desired finish. In cases where a rough wood float finish is sufficient, the above procedure may be executed, omitting the steel troweling. A wood float finish shall be used only when allowed in writing by the Engineer.

c. "Broom Finish" - On exterior work such as sidewalks and where else called for, a broom finish shall be used. The finishing shall be accomplished in the following manner. Screeding shall be done and the surface worked up with a wood float. At a proper time thereafter, the surface shall be steel troweled at least once and more if so directed. Upon completion of troweling, a sufficiently stiff bristled broom shall be drawn lightly across the surface to produce a slightly striated finish. The brooming shall in general be perpendicular to the main traffic route. Coordinate required finish with the Engineer before application.

2. For all of the finishing procedures described, the time element is important and something that must be determined during the progress of the work as conditions warrant. Normally, free water on the surface of concrete should not occur. Allow the concrete surface to dry before starting finishing operations. Do not, under any circumstance, add dry cement to wet areas in order to accelerate drying. Finishing and rubbing required for all parts of the work shall be done only by competent "Cement Finishers" trained for the work.

C. Formed Surfaces

1. Immediately after the end of the wet cure period, remove form ties and patch all tie-holes, rat holes, and other surface voids with a non-metallic, non-shrink grout, which most nearly matches the color and texture of the concrete surface. All protrusions shall be ground smooth with an approved mechanical grinder.

D. Surfaces Requiring Rub Finish

1. Rubbed finish of surfaces shall be provided on all poured interior and exterior vertical concrete surfaces and the underside of horizontal surfaces exposed to view, including all building and structure surfaces. Rubbing shall include but not be limited to:

a. The exterior face of all building foundation walls, platforms and the like, from the top of the walls to 6 inches below grade, the interior faces of all building walls and ceilings, stair risers, retaining walls, stair cheeks, and the like.

2. Surfaces requiring a rubbed finish shall, when completed, shall present a smooth, even textured surface and proper appearance. The Engineer shall be the sole

judge of the acceptability of a rubbed finish. Cement utilized in rubbing shall be of the same type manufacturer and source as that used in batching the concrete. The following procedure shall be required for all surfaces requiring a rubbed finish.

a. Immediately upon removal of the forms, snap all form ties and fill tie holes with non-shrink grout to a point slightly indented from the finished surface. Hand chip all air pockets and laitance covered holes greater than 1/4 inch. A mechanical grinder of a type approved by the Engineer shall then be used to remove any form marks, ribs, or bulges, or other protruding surface defects.

b. The surface shall then be wetted with clean water and a cement (4 parts), presifted fine sand (5 parts), and water grout shall be evenly applied utilizing a sponge float filling all exposed voids. The surface shall be rubbed with a burlap bag and allowed to thoroughly dry.

c. The surface shall again be wetted and the grout reapplied with the sponge float and again rubbed with burlap, removing all excess material.

d. After the final rubbing is completed, the surface shall be thoroughly drenched and kept wet for a period of 7 days unless otherwise directed by the Engineer. No other cement powder, grout or other surface coating will be allowed. Plastering of surfaces requiring a rubbed surface will NOT be tolerated.

3.8 REPAIRING OF HARDENED CONCRETE SURFACES

A. Defective concrete and honeycombed areas shall not be patched unless examined and approval is given by the Engineer. After approval, areas involved shall be cut back to a minimum depth of 1 inch from the finished surface, or as otherwise directed, whichever is greater. Edges of areas to be repaired shall be cut square to a minimum depth of 3/4 inch. Feathered edges will not be allowed. Any voids or honeycomb around reinforcing steel shall be chipped away to provide at least 3/4 inch clearance all around to permit proper placement of repair concrete around the steel to the parent, sound concrete.

B. Exposed surfaces shall be thoroughly cleaned of all mud, paint, grime, scum, laitance, organic matter, detritus, calcareous growth and other foreign matter by sand and water blasting or other acceptable means. Immediately after cleaning, the surface shall be checked by the Engineer for proper surface preparation, including fractured concrete or loose aggregate. Any such material shall be removed using pneumatic or hand tools. The final surfaces shall be thoroughly rinsed with clean water to remove remaining dirt and dust.

C. Premoisten the prepared surface for at least 2 hours to reduce the absorption of water by the parent concrete and to provide a reservoir for moist curing at the interface of the repair. The substrate should be saturated surface dry with no standing water. While the concrete surface is still damp, apply a thin 1/16 inch coat of neat cement slurry (mixed to the consistency of a heavy paste) with a bristle brush to provide a bond coat throughout the entire cavity of the repair. Before the slurry has dried or changed color, promptly install the repair concrete or dry-pack, as may be required or selected.

D. For relatively small areas, ram repair concrete into this portion of the formed void. This concrete shall comprise a crumbly-dry 1-1-1.5 mixture of cement, concrete sand and

pea gravel (or 3/4 inch gravel) mixed slightly damp to the touch (just short of "balling"). The "dry-pack" consistency of the concrete shall be zero slumps, but moist enough so that when it is rodded and tamped until dense, an excess of paste will appear on the surface in the form of a spider web. In cases of unformed voids of thinner section, do not build-up repair in excess of a depth which will sag with the weight of the fresh mortar or concrete. Trowel smooth with heavy pressure.

E. The concrete shall be of the driest possible consistency and mix composition so that it can be worked into the corners and angles of forms and around the reinforcement, without permitting the materials to segregate or free water to collect on the surface, due consideration being given to the methods of placing and compacting. Source and mixture of concrete shall be submitted for approval.

F. Concrete shall be deposited continuously, or in layers of such thickness that no concrete will be deposited which has hardened sufficiently to cause the formation of seams and planes of weakness within the section. Concrete shall be thoroughly consolidated and trowelled dense, smooth and plane. Avoid premature and excessive trowelling which could cause sagging.

G. Repair areas and adjacent parent concrete surfaces shall be continuously moist cured immediately after finishing for at least 7 days. Surfaces shall be covered with damp burlap and sealed with taped polyethylene. Membrane curing compounds shall not be used.

H. Leave finished work and adjacent concrete surfaces in a neat, clean condition with no evidence of spillovers or staining.

3.9 CLEANING

A. Concrete surfaces shall be cleaned of objectionable stains as determined by the Engineer. Materials containing acid in any form or methods which will damage the "skin" of concrete surfaces shall not be employed, except where otherwise specified.

END OF SECTION

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SECTION 05050

WELDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Welding for fabrication and installation of metals

B. Related Sections

1. Section 05500 – Miscellaneous Metals

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. BPVC SEC V, Nondestructive Examination.

2. BPVC SEC IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

B. American Society of Nondestructive Testing (ASNT): SNT-TC-IA, Personnel Qualification and Certification in Nondestructive Testing.

C. American Welding Society (AWS):

1. B2.1, Specification for Welding Procedure and Performance Qualification.

2. D1.1, Structural Welding Code - Steel.

3. D1.2, Structural Welding Code - Aluminum.

4. QC 1, Standard for AWS Certification of Welding Inspectors.

1.3 DEFINITIONS

A. CWI-Certified Welding Inspector.

B. NDT-Nondestructive Testing.

1.4 SUBMITTALS

A. Shop Drawings:

1. Shop and field welding procedure specifications (WPS).

2. Procedure qualification records (PQR).

3. Welding Documentation: Submit on appropriate forms in referenced welding codes.

4. Nondestructive testing procedure specifications prepared in accordance with ASME BPVC SEC V.

B. Quality Control Submittals:

1. Welder/welding operator performance qualifications (WPQ).

2. Certified welding inspector (CWI) credentials.

3. Testing agency personnel credentials.

4. Welding inspector's reports.

5. Shop inspection and quality control records when requested.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Welding Procedure Specifications: In accordance with AWS D1.1 (Annex E) or AWS B2.1 (App. A) or ASME BPVC SEC IX (Forms QW-482 and QW-483).

2. Welding Procedure Specifications: In accordance with AWS D1.1 (Annex E) or AWS B2.1 (App. A) or ASME BPVC SEC IX (Forms QW-482 and QW-483).

3. Welding Inspector: Certified in accordance with AWS QC 1, and having prior experience with the welding codes specified.

4. Testing Agency: Personnel performing tests shall be NDT Level II Certified in accordance with ASNT SNT-TC-1A.

1.6 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Welding fabrication, materials, and workmanship shall be subjected to inspection and testing during the fabrication process.

B. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or permitted by the Engineer.

C. Welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code.

D. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.

E. Notify the Owner's Project Representative prior to the start of any fabrication or other phases of the work to afford them reasonable opportunity to inspect work.

F. A Certified Welding Inspector (CWI) shall be retained by the fabricator to visually inspect all fabrication welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Acceptance Criteria.

G. The CWI shall be present whenever shop welding is performed. The CWI shall perform inspection before, during, and after welding. CWI duties include:

1. Verifying conformance of specified job material and proper storage.

2. Monitoring conformance with approved WPS.

3. Monitoring conformance of WPQ.

4. Inspecting weld joint fit-up and in-process inspection.

5. Providing 100 percent visual inspection of all welds.

6. Supervising nondestructive testing personnel and evaluating test results.

7. Maintaining records and preparing report confirming results of inspection and testing comply with the Work.

H. Maintain inspection and quality control records of shop work.

I. Acceptance of work at the shop shall not prevent its final rejection at the jobsite, even after erection, if it is found to be defective in any way.

J. Nondestructive testing of fabrication welds will be conducted by an independent Testing Agency, retained by the Owner, in accordance with the criteria specified below and in conjunction with the testing required for field welding.

PART 3 EXECUTION

3.1 GENERAL

A. Welding and Fabrication by Welding:

1. Conform to governing welding codes referenced in the attached Welding and Nondestructive Testing Requirements Data Sheet.

2. Each welder working on the project, whether in the shop or in the field, shall be assigned an identification symbol or mark. Each welder shall mark or stamp his identification symbol at each weldment completed, whether in the shop or in the field.

3.2 FIELD QUALITY CONTROL

A. Welding fabrication, materials, and workmanship shall be subjected to inspection and testing during the erection and installation process.

B. Nondestructive testing of erection, installation and fabrication welds will be conducted by an independent Testing Agency, retained by the Owner, in accordance with the weld inspection criteria specified below.

C. The Contractor shall facilitate inspection and testing by the Testing Agency. Furnish the Testing Agency, upon request, with the following:

1. Complete sets of approved shop drawings and corrective work procedures at shop(s) and in the field.

2. Cutting lists, order lists, material bills and shipping lists.

3. Information as to time and place of all rollings and shipment of materials to the shop(s) and the field.

4. Full and ample means and assistance for testing, including access to all field and shop welds required to be tested.

D. Notify the Engineer prior to the start of any erection or installation or other phases of the work to afford reasonable opportunity to inspect the work.

E. Maintain inspection and quality control records of field work.

3.3 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Weld Inspection Criteria:

1. Selection of Welds to be Tested: As agreed upon between Engineer and Contractor.

2. Unless otherwise specified, perform NDT of welds at a spot testing frequency as determined in the attached table in Data Sheet 05050 – A, in accordance with the referenced welding codes, as follows:

a. Butt Joint Welds: All butt welds to be provided shall be radiographically tested and repaired.

b. Groove Welds: All groove welds to be provided shall be ultrasonically tested and repaired.

c. Fillet Welds: A randomly sampled percentage of all fillet welds to be provided shall be examined and repaired, using either dye penetrant or magnetic particle inspection methods.

d. All Welds: 100 percent visually inspected.

3. Weld Acceptance:

a. Visual Inspection (VT):

1) Structural Tubing: AWS D1.1, paragraph 6.9, Visual Inspection, Tubular Connections;

2) All Other Structural Steel: AWS D1.1, paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.

b. Ultrasonic Testing (UT): Perform UT of groove welds in accordance with AWS D1.1, paragraph 6.13.3, Class R Indications.

c. Radiographic Testing (RT): Perform RT of butt joint welds in accordance with AWS D1.1, paragraph 6.12.1.

d. Magnetic Particle (MT):

1) Perform on fillet and partial penetration groove welds in accordance with AWS D1.1, paragraph 6.10.

2) Acceptance shall be in accordance with VT standards specified above.

e. Liquid Penetrant (PT):

1) Perform on fillet and partial penetration groove welds per AWS D1.1, paragraph 6.10.

2) Acceptance shall be in accordance with VT standards specified above.

3.4 WELD DEFECT REPAIR

A. Deficient welds shall be cut out to sound material and rewelded.

B. Verify by retesting that rejected weld defects have been repaired and are acceptable in accordance with the appropriate welding codes.

3.5 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION," are a part of this Specification.

1. DATA SHEET 05050 – A , Welding and Nondestructive Testing Requirements.

END OF SECTION

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DATA SHEET 05050-A
Welding and Nondestructive Testing Requirements

Specification Section	Governing Welding Codes or Standards	Submit Welding Procedure Spec.	Submit Welder/ Welding Operator Qual.	Onsite Welding Inspector Req'd	Submit Written Nondestructive Testing Procedure Specifications	Nondestructive Testing Requirements
05500 Metal Fabrications and Castings	AWS D1.1, Structural Welding Code–Steel	Yes	Yes	Yes	Yes	100% VT[5]; 100% UT[1] or RT[2] of all groove-and-butt joint welds; 10% MT[3] or PT[4] of all fillet welds; see Section 05500

[1]UT–Ultrasonic Testing.
[2]RT–Radiographic Testing.
[3]MT–Magnetic Particle Testing.
[4]PT–Liquid Dye Penetrant Testing.
[5]VT–Visual Testing

SECTION 05050

WELDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Welding for fabrication and installation of metals

B. Related Sections

1. Section 05500 – Miscellaneous Metals

1.2 REFERENCES

A. American Society of Mechanical Engineers (ASME):

1. BPVC SEC V, Nondestructive Examination.

2. BPVC SEC IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.

B. American Society of Nondestructive Testing (ASNT): SNT-TC-IA, Personnel Qualification and Certification in Nondestructive Testing.

C. American Welding Society (AWS):

1. B2.1, Specification for Welding Procedure and Performance Qualification.

2. D1.1, Structural Welding Code - Steel.

3. D1.2, Structural Welding Code - Aluminum.

4. QC 1, Standard for AWS Certification of Welding Inspectors.

1.3 DEFINITIONS

A. CWI-Certified Welding Inspector.

B. NDT-Nondestructive Testing.

1.4 SUBMITTALS

A. Shop Drawings:

1. Shop and field welding procedure specifications (WPS).

2. Procedure qualification records (PQR).

3. Welding Documentation: Submit on appropriate forms in referenced welding codes.

4. Nondestructive testing procedure specifications prepared in accordance with ASME BPVC SEC V.

B. Quality Control Submittals:

1. Welder/welding operator performance qualifications (WPQ).

2. Certified welding inspector (CWI) credentials.

3. Testing agency personnel credentials.

4. Welding inspector's reports.

5. Shop inspection and quality control records when requested.

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Welding Procedure Specifications: In accordance with AWS D1.1 (Annex E) or AWS B2.1 (App. A) or ASME BPVC SEC IX (Forms QW-482 and QW-483).

2. Welding Procedure Specifications: In accordance with AWS D1.1 (Annex E) or AWS B2.1 (App. A) or ASME BPVC SEC IX (Forms QW-482 and QW-483).

3. Welding Inspector: Certified in accordance with AWS QC 1, and having prior experience with the welding codes specified.

4. Testing Agency: Personnel performing tests shall be NDT Level II Certified in accordance with ASNT SNT-TC-1A.

1.6 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, Submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS

2.1 SOURCE QUALITY CONTROL

A. Welding fabrication, materials, and workmanship shall be subjected to inspection and testing during the fabrication process.

B. Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in Building Construction of the AWS and shall only be done where shown, specified, or permitted by the Engineer.

C. Welding shall be done only by welders certified as to their ability to perform welding in accordance with the requirements of the AWS Code.

D. Component parts of built-up members to be welded shall be adequately supported and clamped or held by other adequate means to hold the parts in proper relation for welding.

E. Notify the Owner's Project Representative prior to the start of any fabrication or other phases of the work to afford them reasonable opportunity to inspect work.

F. A Certified Welding Inspector (CWI) shall be retained by the fabricator to visually inspect all fabrication welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Acceptance Criteria.

G. The CWI shall be present whenever shop welding is performed. The CWI shall perform inspection before, during, and after welding. CWI duties include:

1. Verifying conformance of specified job material and proper storage.

2. Monitoring conformance with approved WPS.

3. Monitoring conformance of WPQ.

4. Inspecting weld joint fit-up and in-process inspection.

5. Providing 100 percent visual inspection of all welds.

6. Supervising nondestructive testing personnel and evaluating test results.

7. Maintaining records and preparing report confirming results of inspection and testing comply with the Work.

H. Maintain inspection and quality control records of shop work.

I. Acceptance of work at the shop shall not prevent its final rejection at the jobsite, even after erection, if it is found to be defective in any way.

J. Nondestructive testing of fabrication welds will be conducted by an independent Testing Agency, retained by the Owner, in accordance with the criteria specified below and in conjunction with the testing required for field welding.

PART 3 EXECUTION

3.1 GENERAL

A. Welding and Fabrication by Welding:

1. Conform to governing welding codes referenced in the attached Welding and Nondestructive Testing Requirements Data Sheet.

2. Each welder working on the project, whether in the shop or in the field, shall be assigned an identification symbol or mark. Each welder shall mark or stamp his identification symbol at each weldment completed, whether in the shop or in the field.

3.2 FIELD QUALITY CONTROL

A. Welding fabrication, materials, and workmanship shall be subjected to inspection and testing during the erection and installation process.

B. Nondestructive testing of erection, installation and fabrication welds will be conducted by an independent Testing Agency, retained by the Owner, in accordance with the weld inspection criteria specified below.

C. The Contractor shall facilitate inspection and testing by the Testing Agency. Furnish the Testing Agency, upon request, with the following:

1. Complete sets of approved shop drawings and corrective work procedures at shop(s) and in the field.

2. Cutting lists, order lists, material bills and shipping lists.

3. Information as to time and place of all rollings and shipment of materials to the shop(s) and the field.

4. Full and ample means and assistance for testing, including access to all field and shop welds required to be tested.

D. Notify the Engineer prior to the start of any erection or installation or other phases of the work to afford reasonable opportunity to inspect the work.

E. Maintain inspection and quality control records of field work.

3.3 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Weld Inspection Criteria:

1. Selection of Welds to be Tested: As agreed upon between Engineer and Contractor.

2. Unless otherwise specified, perform NDT of welds at a spot testing frequency as determined in the attached table in Data Sheet 05050 – A, in accordance with the referenced welding codes, as follows:

a. Butt Joint Welds: All butt welds to be provided shall be radiographically tested and repaired.

b. Groove Welds: All groove welds to be provided shall be ultrasonically tested and repaired.

c. Fillet Welds: A randomly sampled percentage of all fillet welds to be provided shall be examined and repaired, using either dye penetrant or magnetic particle inspection methods.

d. All Welds: 100 percent visually inspected.

3. Weld Acceptance:

a. Visual Inspection (VT):

1) Structural Tubing: AWS D1.1, paragraph 6.9, Visual Inspection, Tubular Connections;

2) All Other Structural Steel: AWS D1.1, paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.

b. Ultrasonic Testing (UT): Perform UT of groove welds in accordance with AWS D1.1, paragraph 6.13.3, Class R Indications.

c. Radiographic Testing (RT): Perform RT of butt joint welds in accordance with AWS D1.1, paragraph 6.12.1.

d. Magnetic Particle (MT):

1) Perform on fillet and partial penetration groove welds in accordance with AWS D1.1, paragraph 6.10.

2) Acceptance shall be in accordance with VT standards specified above.

e. Liquid Penetrant (PT):

1) Perform on fillet and partial penetration groove welds per AWS D1.1, paragraph 6.10.

2) Acceptance shall be in accordance with VT standards specified above.

3.4 WELD DEFECT REPAIR

A. Deficient welds shall be cut out to sound material and rewelded.

B. Verify by retesting that rejected weld defects have been repaired and are acceptable in accordance with the appropriate welding codes.

3.5 SUPPLEMENTS

A. The supplements listed below, following "END OF SECTION," are a part of this Specification.

1. DATA SHEET 05050 – A , Welding and Nondestructive Testing Requirements.

END OF SECTION

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DATA SHEET 05050-A
Welding and Nondestructive Testing Requirements

Specification Section	Governing Welding Codes or Standards	Submit Welding Procedure Spec.	Submit Welder/ Welding Operator Qual.	Onsite Welding Inspector Req'd	Submit Written Nondestructive Testing Procedure Specifications	Nondestructive Testing Requirements
05500 Metal Fabrications and Castings	AWS D1.1, Structural Welding Code–Steel	Yes	Yes	Yes	Yes	100% VT[5]; 100% UT[1] or RT[2] of all groove-and-butt joint welds; 10% MT[3] or PT[4] of all fillet welds; see Section 05500

[1]UT–Ultrasonic Testing.
[2]RT–Radiographic Testing.
[3]MT–Magnetic Particle Testing.
[4]PT–Liquid Dye Penetrant Testing.
[5]VT–Visual Testing

SECTION 06100

HEAVY TIMBER CONSTRUCTION

PART 1 GENERAL

1.1 DESCRIPTION

A. The Contractor shall furnish all labor, equipment, materials, tools, supervision, and transportation necessary to perform all operations necessary to furnish and install all items consistent with this Section and as shown on the Drawings.

B. Scope of work includes, but is not limited to the following:

1. Furnishing and installation of all new timber members including pile caps, stringers, fascia, blocking, decking and railings, as shown on the Drawings.

1.2 RELATED SECTIONS

A. Section 05500 – Miscellaneous Metals

1.3 REFERENCES

A. The Commonwealth of Massachusetts State Building Code, latest edition

B. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

D. ASTM D1761 - Testing Mechanical Fasteners in Wood

E. AWPA Analytical Standards: A2-98, A3-00, A9-00, A16-93, A17-97, A18-99

F. AWPA C1 - All Timber Products

G. AWPA C9 - Plywood

H. AWPA C15 - Wood for Commercial-Residential Construction

I. AWPA P5 - Waterborne Preservatives

J. AWPA M4 - Standard for the Care of Preservative Treated Wood Products

K. ICBO ES ER-4981

L. National Evaluation Report (NER): Report No. NER-628

M. National Evaluation Report (NER): Report No. NER-643

N. Inspection Agencies - Inspection agencies and the abbreviations used to reference with lumber grades and species include the following:

ALSA - American Lumber Standards Committee: Softwood Lumber Standards

APA - American Plywood Association

NFPA - National Forest Products Association

RIS - Redwood Inspection Service

NELMA – Northeastern Lumber Manufacturers Association

NLGA - National Lumber Grades Authority (Canadian)

SPIB - Southern Pine Inspection Bureau

WCLIB - West Coast Lumber Inspection Bureau

WWPA - Western Wood Products Association

1.4 QUALITY ASSURANCE

A. The Contractor providing this Work shall submit evidence of suitable experience in this type of work and of the competence and experience of the person in charge at the site. Approval of the Contractor's experience shall be solely based on the judgement of the Engineer. Granting approval by the Engineer shall in no way imply acceptance of responsibility by the Engineer for the Contractor's ability to perform the Work.

B. Quality Mark: All preservative-treated wood members shall bear an end tag or permanent

1. Name of wood treating company
2. Treatment plant city and state
3. Symbol for Micronized Copper Azole (MCA)
4. Preservative retention level
5. Approved use
6. Code report number

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Stack lumber and timber off the ground on skids and under cover in a manner that prevents warping and allows shedding of water. Handle timber with rope or chain slings without dropping, breaking outer fibers, bruising, or penetrating the surface with tools. Do not use cant dogs, peaveys, hooks, or pike poles.

B. The material shall be stored on site in an area which will be designated by the Owner.

C. Timber shall be handled in an approved manner such that the material will not be damaged.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's data to the Engineer not less than 21 days prior to the start of Work. Certify that the following materials meet or exceed the specification requirements outlined in Part 2 – Products, by submitting a notarized copy of chemical and physical test results:

1. New MCA-treated Southern Yellow Pine Timber: The Contractor shall submit to the Engineer for review duplicate copies of licensed independent testing laboratory certification that the materials were free from defects, were properly peeled, seasoned and otherwise prepared for the intended use.

B. At least 4 weeks prior to material delivery, the Contractor shall submit certificates from the treatment plant or qualified testing laboratory and/or lumber supplier attesting that:

1. All timber is free from decay.
2. All timber has been treated in conformance with these Specifications.
3. All timber is of the grade and quality specified herein.

C. The Contractor shall submit a Timber Framing Work Plan stamped/sealed by a Massachusetts Professional Engineer, not less than 21 days prior to starting timber

framing Work. At a minimum, the Timber Framing Work Plan shall include a narrative and drawings describing the following:

1. Complete descriptive data to demonstrate compliance of the materials, procedures and the equipment with these Specifications.
2. Tabular summary of framing identification and order lengths for timber elements.
3. Member dimensions, location, size, and type.

D. Closeout Submittals:

1. Within 7 days of receiving request from the Owner to submit closeout submittals, unless otherwise agreed to by the Owner, submit the following:

a. Heavy Timber Records Summary: Within 2 days of completing installation, submit copies of heavy timber installation records to the Engineer, which shall include a summary of all testing and installation records.

b. Provide As-Built Drawings of installed heavy timber in accordance with Section 01770 Closeout Procedures.

1.7 LINE AND GRADE CONTROL

A. The Contractor shall be responsible for establishing and maintaining line and grade control for all aspects of the Work and as specified on the Drawings. All survey work conducted on the project shall correspond to the site coordinate system and vertical datum as shown on the Drawings.

B. Final grades for timber shall be within the following tolerances:

1. Horizontal tolerance: 0.05 feet
2. Vertical Tolerance:0.05 feet

PART 2 PRODUCTS

2.1 GENERAL

1. Grade Stamps - Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, and moisture content at time of surfacing, and mill.

a. Apply grade stamps to ends or back of each piece or omit grade stamps entirely and issue certificate of grade compliance from inspection agency in lieu of grade stamp.

2. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required, for moisture content specified for each use.

a. Provide dressed lumber, S4S, unless otherwise indicated.

B. All timber shall be new, free of tags and staples, and supplied with nominal dimensions unless otherwise noted.

2.2 MATERIALS

A. Timber and lumber shall be of the nominal dimensions as shown on the Drawings.

B. All horizontal surfaces between timber components shall be covered with 30# tar paper with a 1-inch overhang on all sides. Tar paper shall be overlapped a minimum of six inches at seams.

C. Timber railing components shall be No. 2 Southern Yellow Pine or better, as graded by SPIB, and with design values per the NFPA National Design Specification.

D. Timber decking, stringers, fascia, blocking, and pile caps shall be No. 1 Southern Yellow Pine or better, as graded by SPIB, and with design values per the NFPA National Design Specification.

E. All timber shall be free from defects, which will materially impair strength and durability of the timber member.

F. Deck boards shall be spaced 1/8 inch apart and shall be fastened using #10-8 x 3-inch flat head stainless steel deck screws. Screw holes shall be predrilled to avoid splitting.

2.3 PRESERVATIVE TREATMENT

A. Prior to treatment, all dimension lumber shall be kiln dried. Conditioning by heating is not permitted.

B. All new Southern Yellow Pine timber members shall be treated with Micronized Copper Azole (MCA), a copper-based wood preservative. Minimum retention shall be 0.31 pounds per cubic foot.

C. Treatment shall comply with the AWPA Standard U1: User Specification for Treated Wood, latest edition. Service Condition shall be UC4B – Ground Contact, Heavy Duty. The material shall be applied in accordance with AWPA Standard T1: Processing and Treatment Standard, latest edition.

D. End Cut Preservative: Treat cut ends in accordance with manufacturer's recommendations.

E. All pressure treated timber that has been field cut, dressed, and/or drilled shall be coated with two (2) coats of copper naphthenate, including the ends of any spliced segments.

F. Adhesive: Use adhesives in accordance with manufacturer's recommendations.

2.4 FASTENERS

A. All fastenings and related hardware shall conform to the requirements of Section 05600 – Miscellaneous Metals.

PART 3 EXECUTION

3.1 PREPARATION

A. Prior to installation, all demolition affecting the new work shall be completed.

3.2 INSTALLATION

A. Coat ends of field cut members in accordance with subsection 2.3.F.

B. Joints are to be square, tight, and well-fastened with all members assembled in accordance with the approved Timber Framing and Work Plan and the Drawings.

C. Holes for bolts shall be drilled the same size as the bolt before galvanizing. Holes shall be swapped with two (2) coats of sealing compound as specified herein before installing the bolts.

D. Bolts shall be tightened to provide a solid connection. No more than one (1) washer shall be installed under the bolt head or nut. Bolt threads shall project no more than one bolt diameter beyond the nut.

E. Bore holes for lag bolts in two parts. Lead holes for the shank shall have the same diameter equal to approximately two-thirds of the shank diameter.

F. Counter bore for countersinking wherever smooth faces are indicated or specified.

G. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

H. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

I. All timber shall be cut and fit in such a matter so as to have full bearing over the entire contact surface.

3.3 TEMPORARY SUPPORT

A. The Contractor shall be responsible for providing any temporary support or shoring required during construction.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

END OF SECTION

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SECTION 06110

ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. SECTION INCLUDES

1. Structural framing
2. Plywood sheathing
3. Wood nailers and blocking
4. Miscellaneous framing of openings

B. RELATED SECTIONS

1. Section 06200 – Finish Carpentry
2. Section 08210 – Wood Doors

1.2 REFERENCES

A. The Commonwealth of Massachusetts State Building Code, latest edition

B. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

C. ASTM A446 - Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality

D. ASTM D1761 - Testing Mechanical Fasteners in Wood

E. AWPA Analytical Standards: A2-98, A3-00, A9-00, A16-93, A17-97, A18-99

F. AWPA C1 - All Timber Products

G. AWPA C2 – Lumber, Timber, Bridge Ties and Mine Ties

H. AWPA C9 - Plywood

I. AWPA C15 - Wood for Commercial-Residential Construction

J. AWPA P5 - Waterborne Preservatives

K. AWPA M4 - Standard for the Care of Preservative Treated Wood Products

L. ICBO ES ER-4981

M. National Evaluation Report (NER): Report No. NER-628

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O. Inspection Agencies - Inspection agencies and the abbreviations used to reference with lumber grades and species include the following:

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RIS - Redwood Inspection Service

NELMA – Northeastern Lumber Manufacturers Association

NLGA - National Lumber Grades Authority (Canadian)

SPIB - Southern Pine Inspection Bureau

WCLIB - West Coast Lumber Inspection Bureau

WWPA - Western Wood Products Association

P. Truss Plate Institute (TPI)

1. Recommended Code of Standard Practice for the Metal Plate Connected Wood Truss Industry

2. Quality Control Manual

3. Bracing Wood Trusses: Commentary and Recommendation

4. Design Specification for Metal Plate Connected Wood Trusses

1.3 DEFINITIONS

A. Rough carpentry includes carpentry work not specified as part of other sections and which is generally not exposed, except as otherwise indicated.

1.4 SUBMITTALS

A. Submit shop drawings prepared and sealed by a Massachusetts Registered Structural Professional Engineer showing complete information for fabrication and installation of wood truss. Indicate member dimensions; location, size and type of steel plate truss, including lateral bracing.

1. Indicate layout, dimensions, and identification of each unit corresponding to sequence and procedure of installation. Detail inserts, connections, and joints, including accessories and construction at openings in truss.

2. Provide location and details of anchorage devices that are to be embedded in other construction. Furnish templates if required for accurate placement.

3. Include erection procedure for truss units and sequence of erection.

4. Provide complete design calculations for approval, prepared and sealed by a Massachusetts Registered Professional Structural Engineer.

B. Submit shop drawings of wood blocking installation and other rough carpentry work. Describe proposed methods of installation and anchorage to structure showing sizes, types, thicknesses, connections of wood blocking and related items, including adjoining work by other trades.

C. Take all necessary field measurements before preparation of shop drawings and fabrication. Do not delay progress of the job. If field measurements are not possible prior to fabrication, allow for field cutting and fitting.

D. Manufacturer’s literature for all metal connectors and framing anchors

E. Wood-preservative-treatment data from chemical treatment manufacturer. Include certification of chemical solution and affirm that it complies with indicated treatment standard.

1.5 QUALITY ASSURANCE

A. Design standards shall conform to applicable provisions of NFPA and TPI Specification.

B. Source: For each material type required for the work of this section, provide primary materials that are the product of one manufacturer. Provide secondary or accessory materials that are acceptable to the manufacturers of the primary materials.

1. Alkaline copper quaternary (ACQ) preservative-treated wood products from a single approved source.

2. Wood Treatment Plant Qualifications: Wood treatment plant experienced in performing work of this section which has specialized in the treatment of wood similar to that required for this project, licensed by the manufacturer.

C. Installer: A firm with a minimum of three years experience in type of work required by this section and which is acceptable to the truss manufacturers.

D. Engineering: Provide the services of a Professional Engineer, registered in the Commonwealth of Massachusetts, to design and certify that the work of this section meets or exceeds performance requirements specified.

E. Regulatory Requirements: Provide preservative treatment that complies with the following regulatory requirements:

1. NES Report No. NER-643

2. ICBO ES ER-4981

F. Quality Mark: All ACQ preservative-treated wood members shall bear an end tag or permanent ink stamp indicating the following:

1. Name of wood treating company

2. Treatment plant city and state

3. Symbol for alkaline copper quaternary (ACQ)

4. Preservative retention level

5. Approved use

6. Code report number

1.6 TESTING AND INSPECTION

A. Materials and workmanship under this Section may be subject to inspection in the mill, shop, or field by the Engineer or by qualified inspectors selected by the Engineer and paid directly by the Owner.

B. However, such inspection, wherever conducted, shall not diminish truss fabricator's responsibility too provide his own inspection, testing, and quality control, and to furnish materials and workmanship in accordance with Contract requirements, nor shall

inspector's acceptance of materials or workmanship prevent later rejection of same by Owner or Engineer if defects are discovered.

C. The truss fabricator shall give proper notice to inspection agencies designated by the Engineer and shall allow access and full facilities as required for this inspection.

1.7 DELIVERY, STORAGE AND HANDLING

A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

1. For lumber treated with waterborne chemicals, sticker between each course to provide air circulation.

1.8 PROJECT CONDITIONS

A. Coordination - Fit carpentry work to other work; scribe and cope as required for accurate fit. Correlate location of nailers, blocking, grounds and similar supports to allow attachment of other work.

PART 2 PRODUCTS

2.1 GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Grade Stamps - Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing and mill.

a. Apply grade stamps to ends or back of each piece, or omit grade stamps entirely and issue certificate of grade compliance from inspection agency in lieu of grade stamp.

2. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.

a. Provide dressed lumber, S4S, unless otherwise indicated.

b. Provide lumber with 19% maximum moisture content at time of dressing and shipment for sizes 2" or less in nominal thickness, unless otherwise indicated.

3. Wood nailers for roof shall conform to Factory Mutual's Loss Prevention Data Sheet 1-49.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals:

a. Alkaline copper quaternary (ACQ)

b. Chromated copper arsenate (CCA)

B. End Cut Preservative: Treat cut ends in accordance with manufacturer's recommendations.

C. Adhesive: Use adhesives in accordance with manufacturer's recommendations.

D. Kiln-dry preservative treated lumber and plywood panel material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

E. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

F. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Southern Yellow Pine No. 2 or better per SPIB rules

2.3 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated. No. 2 grade and any of the following species:

1. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA

2. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA

3. Western woods; WCLIB or WWPA

2.4 MISCELLANEOUS LUMBER

A. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:

1. Hem-fir or Hem-fir (north), No. 2 Common grade; NLGA, WCLIB, or WWPA

2. Spruce-pine-fir (south) or Spruce-pine-fir, No. 2 Common grade; NELMA, NLGA, WCLIB, or WWPA

3. Eastern softwoods, No. 2 Common grade; NELMA

4. Northern species, No. 2 Common grade; NLGA

5. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA

2.5 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture and compatible with the pressure treatment chemicals.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M or Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667

C. Power-Driven Fasteners: CABO NER-272

D. Wood Screws: ASME B18.6.1

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

I. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2 (ASTM F 738M and ASTM F 836M, Grade A1 or A4).

2.6 PLYWOOD

A. Roof or floor sheathing shall be APA rated, tongue and groove, exterior grade C-D, 3/4 inch thick plywood or as indicated on the Drawings.

B. Exterior wall sheathing shall be APA rated pressure treated, exterior, grade C-D, 1/2 inch thick plywood.

C. Interior exposed sheathing shall be APA rated, exterior, Type AA, and thickness as shown on Drawings.

D. Subject to compliance with this Section, acceptable manufacturers include:

1. Nudo Products, Inc., Springfield, IL

2. Crane Composites, Channahon, IL

3. Sequentia, Inc., Lawrenceville, GA

4. or equal

2.7 ROOF TRUSSES

A. Roof Trusses shall be shop-fabricated wood trusses complete with hot dipped galvanized steel plate connectors, bridging, bracing and anchorage. They shall be designed, fabricated and installed by a manufacturer with a minimum of three years documented experience. The design of the trusses shall be under the direct supervision of a Professional Structural Engineer registered in the State of Massachusetts. Design the truss in accordance with National Evaluation Service, Inc. Report No. NER-392 for a two-hour fire resistance rating over the chemical mix and storage room.

B. Materials

1. Wood members

a. The chord members shall be machine stressed rated (MSR) graded in accordance to the National Design Specifications for Wood Construction published by National Forest Products Association. The chord members shall have a minimum nominal size of 2 inch by 6 inch.

2. Steel Connector Plates shall be made from 18 gauge minimum Grade A ASTM A 446 class G90 hot dipped galvanized steel. Plates shall be applied to both faces of the truss at each joint.

a. Capacities of plate connectors in wood joints shall be determined in accordance with TPI Specifications.

b. Test connector plates with each species and grade of lumber to be used in truss fabrication.

3. Wind loading: comply with Massachusetts State Building Code, most recent edition.

4. Deflections:

a. Live load deflections shall not exceed L/360 where L is the span of the building.

5. Other Pertinent Information:

a. Span of the wood truss is as shown on the plans with a 10 inch overhang at eaves, and 8 inch overhang at gable ends. The roof is pitched at a slope of 5V:12H and will be bearing on a masonry wall with blocking bearing.

6. The wood truss shall be designed in accordance with Truss Plate Institute (TPI)-85 "Design Specification for Metal Plate Connected Wood Trusses" including supplement. The fabrication shall conform to QST: (TPI-85 Addendum, Appendix P) "Quality Standard for Metal Plate Connected Wood Trusses" and QSP-88 "Quality Standard for Plate Manufacture".

7. Stresses in members and forces in connections shall be determined for design purposes by rational analysis, in accordance with accepted engineering practice, including effects of stresses due to local eccentricities in joints, unless connections are detailed so that eccentricities do not exist.

8. In general, analysis shall assume compression and bending members to be unbraced unless special bracing is detailed or unless continuous bracing can reasonably be inferred from Drawings, in accordance with accepted engineering

practice. Location and types of bracing required by analysis or assumed in design shall be indicated on Shop Drawings.

C. Trusses shall conform to approved Shop Drawings, including sizes, configurations, connector plates and other materials.

D. Joints shall be cut and fit accurately to bear wood to wood. Connector plates shall be undamaged, and shall be well embedded and accurately aligned so as not to introduce eccentricities into joints, unless such eccentricities are accounted for in analysis and design.

E. Splices shall be located only where indicated on approved Shop Drawings.

F. The shop drawings to be submitted shall have sizes and spacing of trusses, loads and truss cambers and framed openings. The design calculations shall be submitted to the Engineer along with the shop drawings. These submittals shall bear the seal of the Registered Professional Engineer supervising the preparation of them.

2.8 ELASTOMERIC JOINT SEALANT

A. Install elastomeric sealant at perimeter joints of the exterior concrete wall and frames of doors, louvers, and wall fans to form a weatherproof, watertight seal.

B. Provide a one-part nonacid-curing silicone sealant - Type S - Grade NS - Class 25. Comply with joint sealant manufacturer's printed installation instructions. Acceptable products include:

1. Chem-Calk N-Cure 2000 - Bostik Construction Products Div.
2. Dow Corning 790 - Dow Corning Corp.
3. Silglaze N SCS 2501 - General Electric Co.
4. 864 - Pecora Corp.
5. Spectrum 1 - Tremco, Inc.
6. or equal.

2.9 AIR COMPRESSOR SHED

A. The building shall support all applicable loads calculated in accordance with ASCE 7-10, based on the following criteria:

1. Roof Live Load -20 psf
2. Snow Load:
   a. P_g: 25 psf
   b. P_f[1]: 25 psf
   c. I_s: 1.00
3. Floor Live Load - 50 psf
4. Roof Dead Load – Calculated self-weight plus 5 psf superimposed
5. Wind Load:
   a. V_{ult}: 140 mph

b. I_w: 1.00

6. Earthquake:

a. S_s: 0.144

b. S_1: 0.053

c. I_e: 1.00

B. Presumed Soil Properties:

1. Site Class (for calculation of earthquake loads): D

2. Allowable bearing pressure: 1000 psf

C. Anchorage to the site slab shall be adequate to resist lateral force and provide minimum factors of safety as follows:

1. Against sliding – 1.5

2. Against overturning – 2.0

D. Architectural Criteria:

1. Use Group / Occupancy: B

2. Building Construction Type: V-B

3. Roof:

a. Minimum Pitch: 6:12

b. Shingles: Asphalt, architectural, with 40-year warranty in commercial applications

c. Ice and water shield: Apply 2-course width from eave

d. Venting: Provide vented soffit, ridge vent, and baffles to ensure minimum 1-inch clearance between roof deck and attic insulation

e. Deck: Provide pressure-treated, APA exterior grade plywood, minimum 5/8" thickness

4. Attic: Provide R-38 minimum fiberglass batt insulation, faced with kraft paper vapor retarder

5. Ceiling: Provide painted gypsum wall board, taped sanded and painted, ½" minimum thickness

6. Walls:

a. Exterior Finish: Cedar shakes with vented backup comprised of vented furring strips (Cor-A-Vent SV-3 or Equal)

b. Weather-Resistant Barrier: Tyvek, Typar, or Equal

c. Sheathing: Pressure treated, APA exterior grade plywood, minimum ½" thickness

d. Insulation: Closed-cell polyurethane spray foam, R-20 minimum

e. Doors and Windows: Insulated, grade to match wind load, with vinyl exterior finish

f. Interior Finish: Painted gypsum wall board, taped sanded and painted, ½" minimum thickness

g. Interior Trim: Painted poplar

h. Exterior Trim: Cellular PVC with concealed fasteners – provide Azek, Kleer, or CertainTeed

i. Wall Base: Vinyl cove base, 4" height

7. Floor Finish: Apply penetrating densifier/sealer to concrete floor. Provide Ashford Formula, L&M Seal-Hard, Prosoco Consolideck LS or Equal.

2.10 ACCESS DOOR AND FRAME

A. The door assembly shall be of insulated fiberglass construction with vinyl casing, rated for the applicable wind load and insulating and infiltration resistance requirements of the referenced Codes.

B. The threshold shall comply with 2010 ADA Requirements for Design.

C. One (1) Best heavy-duty cylindrical lock set and latch protector shall be installed per door.

D. A 1 ½" x 2 ½" aluminum drip strip, National Guard, shall be installed above the door.

E. The Contractor shall provide temporary locks for approved cylinders for the construction period. The Contractor shall coordinate keying requirements with the Owner and shall install lock cylinders accordingly upon final completion.

2.11 ELECTRICAL COMPONENTS

Refer to Electrical Drawings and Specifications for all power and lighting requirements.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

C. Cutting, framing and fitting shall be done as necessary for the accommodation of other work. The use of wood chips, shims, or other shrinkable material for leveling will not be permitted. Holes shall be bored accurately for bolts and as required to prevent splitting wood. Bolts shall be drawn up tight.

D. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.

E. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

F. Select pressure treated members in accordance with appropriate untreated lumber and plywood span tables. Provide ventilation of building cavities as required by code.

G. Install pressure treated wood in accordance with requirements of applicable codes. Avoid milling operations that could adversely affect preservative characteristics of ACQ treated wood.

H. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. Massachusetts State Building Code, most recent edition

2. CABO NER-272 for power-driven fasteners

3. Published requirements of metal framing anchor manufacturer

4. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the Uniform Building Code

5. Table 2305.2, "Fastening Schedule," in the BOCA National Building Code

6. Table 2306.1, "Fastening Schedule," in the Standard Building Code

7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in the International One- and Two-Family Dwelling Code

I. Make tight connections between members. Install fasteners without splitting of wood; predrill as required.

3.2 WOOD FURRING, GROUNDS, NAILERS, AND BLOCKING

A. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate location with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

C. Provide wherever shown and where required for screeding or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

D. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.

E. Install treated wood nailers, blocking and plywood at locations indicated on Drawings.

F. Install continuous wood nailers at the perimeter of the entire roof and around roof projections and penetrations as shown on the Drawings.

G. Contractor shall conduct pullout tests prior to start of nailer, blocking and plywood installation.

H. Nailers shall be anchored to resist a minimum force of 300 pounds per lineal foot in any direction. A 1/2 inch space shall be provided between nailer lengths. Individual nailer lengths shall not be less than 3 feet long. Nailer fastener spacing shall not exceed 12

inches on center. Fasteners shall be staggered 1/3 the nailer width and installed within 6 inches of each end. Nailer attachment shall meet this requirement and that of the current Factory Mutual Loss Prevention Data Sheet 1-49.

I. Thickness of nailers and woodwork shall be as indicated on Drawings to match substrate or insulation height to allow smooth transition.

J. Wood nailers and woodwork are generally indicated in nominal lumber sizes, where required, whether indicated or not, the roofing contractor shall furnish, ripped, continuous, plywood shims to create nailer heights to match conditions.

3.3 PLYWOOD

A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

B. Comply with "Code Plus" provisions in above-referenced guide.

3.4 FRAMING

A. Headers shall be provided around all openings as shown on the Drawings or as required to support all structural members. Headers shall be of the same dimension and material as the structural members, or sized as required to comply with the Massachusetts State Building Code most recent edition. Headers shall be doubled and securely fastened together.

B. Sheathings shall be of the sizes shown on the Drawings and shall be secured perpendicular to the framing members with ends staggered as follows or in accordance with local building codes, whichever is more stringent.

1. Wall sheathing shall be fastened using 8d common nails spaced 6 inches o.c. along all supported panel edges and 12 inches on center for interior supports.

2. Gable wall sheathing shall be fastened using 8d common nails spaced 4 inches o.c. along all supported panel edges and 12 inches on center for interior supports.

3. All floor and roof sheathing shall be fastened using 10d common nails spaced 6 inches o.c. along all supported panel edges and 10 inches on center for interior supports. Tongue and groove sheathing shall be used on floors and roofs.

C. Joists and rafters shall be of the sizes indicated on the plans and shall be full length between supports, spaced as indicated on the plans and securely fastened to all supports. Metal hangers shall be used where joists and rafters frame into the sides of beams and as shown on the plans.

D. Blocking shall be provided for all joists and horizontal framing members with a span greater than 8 feet. Blocking shall match joist size and be securely fastened at each end with three, 16d common nails.

E. Set structural members level and plumb, in correct position.

F. Place horizontal members, crown side up.

G. Construct framing members full length without splices.

H. Double members at openings over 24 inches wide. Space short studs over and under opening to stud spacing.

I. Construct double joist headers at floor and ceiling openings and under wall stud partitions parallel to floor joists. Frame rigidly into joists.

J. Bridge joists in excess of 8 foot spans. Fit solid blocking bridging at ends of members.

3.5 ROOF TRUSSES

A. The wood trusses shall be installed in accordance with the manufacturer's instructions.

B. Trusses must be securely braced both during erection and after permanent installation in accordance with "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses (DSB-89)" published by the Truss Plate Institute, Inc. The members shall be set level and plumb and in correct position. Erection bracing shall be used to maintain them straight and plumb until decking and permanent truss bracing has been fastened forming a structurally sound roof framing system. Erection and permanent bracing shall be installed and securely fastened before application of any load.

C. Handling and installation shall follow the "Commentary and Recommendations for Handling, Installing and Bracing Metal Plate Connected Wood Trusses (HIB-91)" by TPI.

D. Attach trusses with an 18-gage minimum hurricane connector plate to the top plate at both ends of each truss, unless other connection is required by Drawings.

3.6 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

END OF SECTION

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SECTION 08110

STEEL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Hollow metal doors and frames

B. Related Sections

1. Section 08710, Door Hardware – Templates for hardware, reinforcing and cut-outs in doors and frames and the furnishing of all hardware.

1.2 REFERENCES

A. ANSI A250.8 (Formerly SDI-100) – Recommended Specifications for Standard Steel Doors and Frames

B. Steel Door Institute (SDI-105) – Recommended Erection Instruction for Steel Frames

C. Door and Hardware Institute – Recommended Locations for Builder's Hardware

D. ANSI A115 – Specification for Door and Frame Preparation for Hardware

E. ASTM A90 – Standard Test Method for Weight (Mass) of Coating on Iron or Steel Articles with Zinc or Zinc-Alloy Coatings

F. ASTM A153 – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

G. ASTM A568 – Standard Specification for Steel, Sheet, Carbon and High-Strength, Low Alloy, Hot-Rolled Sheet and Cold-Rolled Sheet

H. ASTM A653 – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process

I. ASTM A1008 – Standard Specification for Steel, Sheet, Cold-Rolled Carbon, Structural, High Strength Low-Alloy and High Strength Low Alloy with Improved Formability

J. ASTM A1011 – Standard Specification for Steel, Sheet and Strip – Hot Rolled, Carbon Structural, High Strength Low-Alloy and High Strength Low Alloy with Improved Formability

K. ASTM C1363 – Standard Test Method for the Thermal Performance of Building Assemblies by Means of a Guarded Hot Box

L. ASTM E2074 – Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side Hinged and Pivot Swinging Door Assemblies

1.3 SUBMITTALS

A. Product Data – Submit manufacturer's technical product data substantiating that products comply with these requirements.

B. Shop Drawings – Submit for fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

1. Provide schedule of doors and frames using same reference number for details and openings as those on Contract Drawings.

2. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with ANSI A250.8 and as specified in this section.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver hollow metal work in cartons or crates to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished doors.

B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to Engineer; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4 inch high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove carton immediately. Provide ¼ inch spaces between stacked doors to promote air circulation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

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

1. Ceco Door Products

2. Curries Mfg., Inc.

3. E.H. Frederick Co.

4. The Philipp Manufacturing Co.

5. Pioneer Industries, Inc.

6. or equal.

2.2 MATERIALS

A. Hot-Rolled Steel Sheets and Strip – Commercial quality carbon steel, pickled and oiled, complying with ASTM A1011 and ASTM A568.

B. Cold-Rolled Steel Sheets – Commercial quality carbon steel, complying with ASTM A1008 and ASTM A568.

C. Galvanized Steel Sheets – Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A90 and ASTM A653, G60 zinc coating, mill phosphatized.

D. Supports and Anchors – Fabricate of not less than 18 – gauge galvanized sheet steel.

E. Inserts, Bolts and Fasteners – Manufacturer's standard units, except hot-dip galvanized items to be built into exterior walls, complying with ASTM A153, Class C or D as applicable.

2.3 STEEL DOORS AND FRAMES FABRICATION, GENERAL

A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment, to assure proper assembly at project site. Comply with ANSI A250.8 Level 3, extra heavy-duty, Model 3 or 4, minimum 16-gauge faces for doors and 14 gauge for frames.

B. Fabricate frames, concealed stiffeners reinforcement, edge channels and moldings from either cold-rolled or hot-rolled steel (at fabricator's option).

C. Fabricate doors, panels, and frames from galvanized sheet steel. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gauge inverted steel channels.

D. Exposed Fasteners – Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts.

E. Thermal-Rated (Insulating) Assemblies – Provide doors which have been fabricated as thermal insulating door and frame assemblies and tested in accordance with ASTM C236.

1. Unless otherwise indicated, provide thermal-rated assemblies with U factor of 0.24 Btu/(hr. x ft^2 x ºF)

F. Fire-Rated Door Assemblies – Where fire-rated door assemblies are indicated or required, provide fire-rated door and assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E2074 "Standard Methods of Fire Tests of Door Assemblies" by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.

G. Finish Hardware Preparation – Prepare doors and frames to receive mortised and concealed finish hardware in accordance with Section 08710 and final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.

H. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

I. Locate finish hardware as indicated on final shop drawings or, if not shown, in accordance with "Recommended Locations for Builder's Hardware", published by the Door and Hardware Institute.

2.4 STANDARD STEEL FRAMES

A. Provide metal frames for doors, transoms, sidelights, borrowed lights, and other openings, of types and styles as shown on Drawings and schedules. Conceal fastenings,

unless otherwise indicated. Fabricate frames of minimum 14-gauge cold-rolled furniture steel.

1. Fabricate frames with mitered and welded corners.

B. Door Silencers – Except on weather-stripped frames, drill stops to receive 3 silencers on strike jambs of single-swing frames and 2 silencers on heads of double-swing frames.

C. Plaster Guards – Provide 26-gauge steel plaster guards or mortar boxes, welded to frame, at back of finish hardware cutouts where mortar or other materials might obstruct hardware operation and to close off interior of openings.

2.5 SURFACE PREPARATION AND PAINTING

A. Provide primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: As selected by Engineer from manufacturer's full range.

D. Metal Primers:

a. Alkyd Anticorrosive Metal Primer: MPI #79.

b. Rust-inhibitive Primer (Water Based): MPI #107.

c. Cementitious Galvanized-Metal Primer: MPI #26.

E. Opaque Finish:

1. Latex Paints:

a. High-Performance Architectural Latex Eggshell – Gloss Level 3: MPI #139.

b. High-Performance Architectural Latex Satin – Gloss Level 4: MPI #140.

PART 3 EXECUTION

3.1 INSTALLATION

A. General – Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.

B. Placing Frames – Comply with provisions of SDI-105 "Recommended Erection Instructions For Steel Frames", unless otherwise indicated.

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

2. Install fire-rated door frames in accordance with NFPA Std. No. 80.

3. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with tapping screws.

C. Door Installation

1. Fit hollow metal doors accurately in frames, within clearances specified in ANSI A250.8.

2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3.2 ADJUST AND CLEAN

A. Prime Coat Touch-up – Immediately after erection

B. Protection Removal – Immediately prior to final inspection, remove protection plastic wrappings from prefinished doors.

C. Final Adjustments – Check and re-adjust operating finish hardware items, leaving steel doors and frames undamaged and in complete and proper operating conditions.

END OF SECTION

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SECTION 08210

WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Wood Doors and Panels: Fire-Rated and Non-Fire-Rated
2. Flush Wood Doors and Panels with Veneer Facings
3. Pre-Fit and Pre-Machine Pre-Finished Wood Doors

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM)

1. ASTM E90 – Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

B. Architectural Woodwork Institute (AWI)

1. AWI Section 1300

C. Massachusetts State Building Code, latest edition.

D. National Fire Protection Association (NFPA)

1. NFPA 80 – Standards for Fire Doors.

E. Window and Door Manufacturers Association (WDMA)

1. I.S.1-A – Industry Standard for Architectural Flush Wood Doors.

1.3 SUBMITTALS

A. Action Submittals

1. Product Data: Door manufacturer's technical data for each type of door, including details of core and edge construction, trim for openings and louvers, and factory-finishing specifications.
2. Shop Drawings: Submit shop drawings indicating location and size of each door, species of each door, elevation of each kind of door, details of construction, location and extent of hardware blocking, fire ratings, other pertinent data.
    a. For factory-premachined doors, indicate dimensions and locations of cutouts for locksets and other cutouts adjacent to light and louver openings.
3. Manufacturers Instructions: Submit manufacturer’s instructions for care and handling and submit instructions for sealing door edges.

1.4 QUALITY ASSURANCE

A. Quality Standards: Comply with the following standards:

1. NWWDA Quality Standard: I.S.1 "Industry Standard for Wood Flush Doors", of National Wood Window and Door Association (NWWDA).

2. AWI Quality Standard: "Architectural Woodwork Quality Standards", including Section 1300 "Architectural Flush Doors", of Architectural Woodwork Institute (AWI) for grade of door, core construction, finish and other requirements exceeding those of NWWDA quality standard.

B. Manufacturer: Obtain doors from a single manufacturer.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect doors during transit, storage and handling to prevent damage, soiling and deterioration. Comply with requirements of referenced standards and recommendations of NWWDA pamphlet "How to Store, Handle, Finish, Install, and Maintain Wood Doors", as well as with manufacturer's instructions.

B. Identify each door with individual opening numbers which correlate with designation system used on shop drawings for door, frames, and hardware, using temporary, removable or concealed markings.

1.6 PROJECT CONDITIONS

A. Conditioning: Do not deliver or install doors until conditions for temperature and relative humidity have been stabilized and will be maintained in storage and installation areas during remainder of construction period to comply with the following requirements applicable to project's geographical location:

1. Referenced AWI quality standard including Section 100-S-3 "Moisture Content".

1.7 WARRANTY

A. Door Manufacturer's Warranty: Submit written agreement on door manufacturer's standard form signed by Manufacturer, Installer and Contractor, agreeing to repair or replace defective doors that have warped (bow, cup or twist) or that show telegraphing of core construction in face veneers, or do not conform to tolerance limitations of referenced quality standards for the life of the installation.

B. Contractor's Responsibilities: Replace or refinish doors where Contractor's work contributed to rejection or to voiding of manufacturer's warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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

1. Solid Core Doors with Wood Veneer Faces:

a. Algoma Hardwoods, Inc.

b. Eggers Industries, Architectural Door Division.

c. Graham Essex.

d. Weyerhauser Company.

2.2 INTERIOR FLUSH WOOD DOORS

A. Solid Core Doors for Transparent Finish: Comply with the following requirements:

1. Faces: Rift sawn oak without sapwood.

2. AWI Grade: Premium.

3. Veneer Matching: Running match

4. Construction: Particleboard core, 5 or 7 ply.

B. Faces and AWI Grade: Provide faces and grade to match non-rated doors in same area of building, unless otherwise indicated.

1. Construction: Manufacturer's standard core construction as required to provide fire-resistance rating indicated.

2. Edge Construction: Provide manufacturer's standard laminated edge construction for improved screw-holding capability and split resistance as compared to edges composed of a single layer of treated lumber.

2.3 FABRICATION

A. Fabricate flush wood doors to produce doors complying with following requirements:

1. Factory pre-fit and pre-machine doors to fit frame opening sizes indicated with the following uniform clearances and bevels:

a. Comply with tolerance requirements of AWI for pre-fitting.

b. Comply with final hardware schedules and door frame shop drawings and with hardware templates.

c. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before proceeding with factory premachining.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine installed door frames prior to hanging door:

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.

2. Reject doors with defects.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: Refer to Section 08710, Door Hardware.

B. Manufacturer's Instructions: Install wood doors to comply with manufacturer's instructions and of referenced AWI standard and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames in accordance with requirements of NFPA No. 80.

C. Fit doors to frames for uniform clearance at each edge.

3.3 ADJUSTING AND PROTECTION

A. Operation: Re-hang or replace doors which do not swing or operate freely.

B. Finished Doors: Repair or replace doors damaged during installation as directed by the Engineer.

C. Protect doors as recommended by door manufacturer to ensure that wood doors will be without damage or deterioration at time of Final Completion.

END OF SECTION

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SECTION 08710

DOOR HARDWARE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Finish hardware including the following:

a. Hinges and butts.

b. Lock cylinders and keying.

c. Locks, latches, and bolts.

d. Door trim units.

e. Weatherstripping.

f. Thresholds.

g. Silencers.

h. Surface bolts.

i. Astragals.

B. Related Sections

Section 08110 - Steel Doors and Frames

1.2 REFERENCES

A. ANSI/BHMA A156 series.

B. ADA Accessibility Guidelines for Buildings and Facilities.

C. Door and Hardware Institute - Recommended Locations for Builders' Hardware.

1.3 QUALITY ASSURANCE

A. Manufacturer - Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from only one manufacturer (except where noted in the Schedule), although several may be indicated as offering products complying with requirements.

B. Comply with all Federal, State, and Local Codes for handicap accessibility.

1.4 SUBMITTALS

A. Product Data - Submit manufacturers' technical product data for each item of hardware. Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.

B. Hardware Schedule - Submit final hardware schedule in manner indicated below. Coordinate hardware with doors, frames and related work to ensure proper size, thickness, hand function and finish of hardware. Refer to Section 08110, Steel Doors and Frames.

1. Final Hardware Schedule Content - Based on finish hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:

    a. Type, style, function, size and finish of each hardware item.

    b. Name and manufacturer of each item.

    c. Catalog cuts of each item.

    d. Fastenings and other pertinent information.

    e. Location of hardware set cross-referenced to indications on Drawings both on floor plans and in door schedule.

    f. Explanation of all abbreviations, symbols, codes, etc. contained in schedule.

    g. Mounting locations for hardware.

    h. Door and frame sizes and materials.

C. Submittal Sequence - Submit schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of the hardware schedule.

1. Keying Schedule - Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks have been fulfilled.

D. Samples - Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware upon request of Engineer, submit one sample of each type of exposed hardware unit, finished as required, and tagged with full description for coordination with schedule.

1. Samples will be returned to the supplier. Units which are acceptable and remain undamaged through submittal, review and field comparison procedures may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

E. Templates - Furnish hardware templates to each fabricator of doors, frames and other work to be factory-prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

1.5 PRODUCT HANDLING

A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.

B. Packaging of hardware is the responsibility of supplier. As material is received by hardware supplier from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.

C. Inventory hardware jointly with representatives of the hardware supplier and the hardware installer until each is satisfied that the count is correct.

D. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.

E. Provide secure lock-up for hardware delivered to the project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

1.6 KEY CONTROL SYSTEM

A. Provide hardware and keys compatible with Owners existing key control system.

PART 2 PRODUCTS

2.1 GENERAL

A. Coordinate all hardware with the Engineer.

B. Hand of Door - Drawings show direction of swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.

C. Manufacturer's Name Plate - Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Engineer.

1. Manufacturer's identification will be permitted on rim of lock cylinders only.

D. Base Metals - Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially recognized) quality than specified for the applicable hardware units by applicable ANSI/BHMA A156 series standard for each type hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise approved.

E. Fasteners - Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.

F. Furnish screws for installation, with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.

G. Provide concealed fasteners for hardware units that are exposed when door is closed, except to the extent that no standard units of the type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on the opposite face is exposed in other work, except where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use hexscrew fasteners.

H. Tools and Maintenance Instructions for Maintenance - Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

I. Hardware Finishes

1. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set for color and texture.

2. Provide finishes that match those established by BHMA.

3. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than specified for the applicable units of hardware by referenced standards.

4. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze and aluminum, except as otherwise indicated. The suffix "-NL" is used with standard finish designations to indicate "no lacquer".

5. The designations used in schedules and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18, Materials & Finishes Standard, including coordination with the traditional US finishes shown by certain manufacturers for their products.

2.2 ACCEPTABLE MANUFACTURERS

A. Hinges and Butts - Hager Companies, Lawrence Hardware, Pemko Manufacturing Company, Stanley, or equal.

B. Locks - Sargent, Schlage, Yale, or equal.

C. Bolts - Ives, Rockwood, Corbin-Russwin, Sargent, Stanley, or equal.

D. Door Trim Units - Baldwin, Brookline, Rockwood, or equal.

E. Door Stripping and Seals - National Guard, Pemko, Reese, Zero, or equal.

F. Thresholds - National Guard, Pemko, Reese, Zero, or equal.

G. Astragals - National Guard, Pemko, Reese, Zero, or equal.

2.3 HINGES AND BUTTS

A. Comply with ANSI/BHMA A156.1

B. Templates - Provide only template-produced units.

C. Screws - Furnish Phillips flat-head or machine screws for installation of units. Finish screw heads to match surface of hinges or pivots.

D. Hinge Pins - Except as otherwise indicated, provide hinge pins as follows:

1. Steel Hinges - Steel pins.

2. Exterior Doors - Non-removable pins.

3. Out-swing Corridor Doors - Non-removable pins.

4. Interior Doors - Non-rising pins.

5. Tips - Flat button and matching plug, finished to match leaves.

6. Number of Hinges - Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90-inches or less in height and one additional hinge for each 30-inches of additional height.

E. Provide Stanley Model No. FBB199 - US32D, 4½ by 4½ inch hinges, Hager Model BB1199, or equal.

2.4 LOCK CYLINDERS AND KEYING

A. General - Meet with the Engineer and Owner to finalize keying requirements and obtain final instructions in writing.

B. Metals - Construct lock cylinder parts from brass/bronze, stainless steel and nickel silver.

C. Comply with Engineer's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.

1. Permanently inscribe each key with number or lock that identifies cylinder manufacturer key symbol, and notation "DO NOT DUPLICATE".

D. Key Material - Provide keys of nickel silver only.

E. Key quantity - Furnish 5 change keys for each lock; 5 master keys for each master system; and 5 grandmaster keys for each grandmaster system.

1. Deliver keys to Owner.

2. Furnish 5 construction master keys.

F. Equip all locks with interchangeable cores constructed of solid brass for final and construction cores.

2.5 LOCKS, LATCHES AND BOLTS

A. Cylindrical Locks - Comply with ANSI/BHMA 156.2 Series 4000 Grade 1.

B. Mortise Locks - Comply with ANSI/BHMA A156.13 Series 1000 Grade 1 operational, Grade 3 security.

C. Strikes - Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set.

1. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

2. Provide roller type strikes where recommended by manufacturer of the latch and lock units.

D. Lock Throw - Provide 5/8 inch minimum throw of latch and deadbolt used on pairs of doors.

1. Provide ½ inch minimum throw on other latch and deadlock bolts.

E. Rabbeted Doors - Where rabbeted door stiles are indicated, provide special rabbeted front on lock and latch units and bolts.

F. Exit devices comply with ANSI/BHMA A156.3.

G. For exterior single doors, provide Sargent Model No. 8913 ETL – US32D lockset/exit device, or equal.

H. For exterior double doors, provide Sargent Model No. 8713 ETL – US32D lockset/exit device, equal by Corbin-Russwin, or equal.

I. For interior single doors used for egress where an exit device is required, provide Sargent Model No. 8913 ETL – US32D lockset/exit device, or equal.

J. For interior single doors where locking is not required, provide Sargent Model No. 10U15xLL – US32D lockset or equal.

K. For interior single doors in office or similar areas where locked doors are required, provide Sargent Model No. 10G05xLL – US32D lockset or equal.

L. For interior single doors in bathroom areas, provide Sargent Model No. 8221 lockset (cylinder vs. thumbturn), or equal.

M. Provide Ives Model No. 458 flush bolt, Hager Model 282 D, or equal.

2.6 CLOSERS AND DOOR CONTROL DEVICES

A. Door control devices comply with ANSI/BHMA A156.4.

B. Size of Units - Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit, depending upon size of door, exposure to weather and anticipated frequency of use.

1. Provide regular arms for all overhead closers, except as otherwise indicated.

2. Provide closers with reduced opening force for all handicap accessible doors.

3. Provide closers with stops where door stops are not indicated or appropriate.

C. Provide grey resilient parts for exposed bumpers.

D. Provide Rockwood Model No. 440 floor stop, or equal.

E. Provide Rockwood Model No. 400 wall stop, or equal.

F. Provide Rockwood Model No. 461 kick down door stop, or equal.

G. Provide Ives Model No. 180 lockguard, equal by Hager, or equal.

2.7 DOOR TRIM UNITS

A. Fasteners - Provide manufacturer's standard exposed fasteners for door trim units (push plates, pull plates, kick plates, edge trim, and similar units); either machine screws or self-taping screws.

2.8 WEATHERSTRIPPING

A. Provide continuous weatherstripping at each edge of every exterior door leaf. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.

B. Replaceable Seal Strips - Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.

C. Weatherstripping at Jambs and Heads:

1. Provide bumper-type resilient insert and metal retainer strips, surface-applied unless shown as mortised or semi-mortise, of following metal, finish and resilient bumper material:

2. Extruded aluminum with natural anodized finish; 0.062 inch minimum thickness of main walls and flanges.

3. Extruded bronze (brass), finish to match door/frames, 0.05 inch minimum thickness of main walls and flanges.

4. Provide Pemko Model No. 305CR weatherstrip, National Guard Products Model 140PA, or equal.

D. Weatherstripping at Door Bottoms

1. Provide threshold consisting of contact type resilient insert and metal housing of design and size shown; of following metal, finish, and resilient seal strip:

a. Extruded aluminum with natural anodized finish; 0.062 inch minimum thickness of main walls and flanges.

b. Solid neoprene wiper or sweep seal complying with MIL R 6055, Class II, Grade 40.

c. Provide Pemko Model No. 315CN door bottom sweep, equal by National Guard Products, or equal.

E. Astragals

1. Provide Pemko Model No. 357C astragal, or equal.

2.9 THRESHOLDS

A. General - Except as otherwise indicated provide standard aluminum threshold unit of type, size and profile as shown or scheduled.

B. Exterior Hinged/Pivoted Doors - Provide units not less than the width of the door frame, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames, and as follows:

1. For out-swinging doors provide rabbeted type units with replaceable weatherstrip insert in stop.

C. Provide Pemko Model No. 172A threshold, Reese Model S426A, or equal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations of "ADA Accessibility Guidelines for Buildings and Facilities - Federal Register/Vol. 56, No. 144, 7-26-91", and except as may be otherwise directed by the Engineer.

B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface projections with finishing work specified under other specifications. Do not install surface-mounted items until finishes have been completed on the substrate.

C. Set units level, plumb and true to lien and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.

3.2 ADJUST AND CLEAN

A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as indicated for the application made.

B. Clean adjacent surfaces soiled by hardware installation.

C. Final Adjustment - Wherever hardware installation is made more than one month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

D. Instruct Owner's personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.

END OF SECTION

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SECTION 15050

PIPING - GENERAL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Permit requirements and documentation
2. Sleeves and seals for all wall, floor and roof penetrations
3. Escutcheons
4. Wall Pipes
5. Anchor bolts
6. Pipe and equipment coatings
7. Piping installation
8. Testing
9. Cleaning
10. Pressure testing
11. Disinfection

1.2 REFERENCES

A. ASTM A778 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products

B. ASTM A36 – Specification for Carbon Structural Steel

C. American Water Works Association, AWWA C651, AWWA Standard for Disinfecting Water Mains

D. Massachusetts General Laws – 522 CMR 17.00 Piping

1.3 SUBMITTALS

A. Material specifications and shop drawings for all materials and equipment furnished under this Section

B. Layout drawing for hangers and supports

C. Certificates of Compliance on all pipe materials

D. Pipeline testing and disinfection procedures

1.4 QUALITY ASSURANCE

A. The location of all equipment, fixtures, and piping is considered to be approximate only and the Engineer has the right to change at any time before the work is installed, the position of equipment and piping to meet structural conditions, avoid interferences,

provide proper clearances or for other sufficient causes. Such changes shall be made without additional expense to the Owner.

B. Secure all permits and pay all fees required to carry out the piping work. Comply with all laws, ordinances, codes, rules, and regulations of the local and state authorities having jurisdiction over any of the work specified herein. Where provisions of the Contract are in conflict with the codes, the more stringent of either the codes or the Contract Documents shall govern.

C. The drawings and diagrammatics show the pipe sizes and general routing. Offsets and fittings required to avoid field interferences and provide improved layout shall be provided at no additional cost to the Owner.

D. All pipe, tube, hose, and fittings in a given specification section shall be the product of a single manufacturer who is experienced in the manufacture of the materials to be furnished. The manufacturer must have provided materials which have be successfully installed and operated for at least 5 years in a similar application.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Care shall be taken in loading, transporting, and unloading to prevent damage to the pipe or coatings. Pipe or fittings shall not be dropped. All pipe or fittings shall be examined before installing, and no piece shall be installed which is found to be defective. Any damage to the pipe linings or coatings shall be repaired as directed by the Engineer at no additional cost to the Owner.

B. If any defective pipe is discovered after it has been installed, it shall be removed and replaced with a sound pipe in a satisfactory manner. All pipe and fittings shall be thoroughly cleaned before installing, shall be kept clean until they are used in the work, and when installed shall conform to the lines, grades and dimensions required.

C. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture. Protect stored pipes and tubes. Elevate above grade and enclose with durable, waterproof wrapping. When stored inside, do not exceed structural capacity of the floor. Protect flanges, fittings, and specialties from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

PART 2 PRODUCTS

2.1 MATERIALS

A. Sleeves and Seals - Furnish all sleeves required under this Division. Coordinate the sleeve locations and elevations for placement.

1. Sleeves will be required at the locations shown on the Drawings or as specified herein. The type of wall penetration shown on the Drawings shall govern over the summary presented herein.

2. Sleeves shall be Schedule 5S stainless steel in accordance with ASTM A-778 with seep rings. Seep rings shall be welded continuous, placed on the center of the sleeve and project 3 inches. Floor sleeves shall be 3 inches longer than the floor slab depth and shall project 3 inches above finish floor level for housekeeping purposes. Wall sleeves shall be the same length as the wall thickness. Sleeves passing through partition walls do not require seep rings.

3. Sleeves for carrier pipes 1 inch diameter and less shall be Type WSK as manufactured by O.Z. Electrical Manufacturing Company, Brooklyn, NY, Wall-Seal by Dresser Manufacturing, GPT/Thunderline, or equal.

4. HVAC Sleeves:

   a. Sleeves for Pipes Through Non-fire Rated Floors: 18 gage thick galvanized steel.

   b. Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

   c. Sleeves for Round Ductwork: Galvanized steel.

   d. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

   e. Sealant: Acrylic.

5. Sleeves with seals as described hereinafter shall be used for all carrier pipes larger than 1 inch in diameter. Seals between steel sleeve and carrier pipe shall be made using "Linkseal" as manufactured by GPT/Thunderline Corporation, Pen-Seal as manufactured by Proco Products, Innerlynx or equal. Sizing of sleeves, selection of link model numbers and sizes shall be in strict accordance with the manufacturer's instructions to ensure watertightness.

   a. Same environment on both sides of wall or floor - sleeves are required. No seal between the pipe and sleeve is required in these locations.

   b. Pipes passing through foundation walls with soil on both sides - pipes shall pass through an oversized opening. Sleeves with seals are not required at these locations.

   c. Sanitary soil pipes, floor drain pipes, and roof drain pipes passing through walls and floors between areas of different environments - water stopped sleeves shall be used and sealed as described above.

6. Pipes penetrating a concrete floor poured on soil above grade shall be poured in place. Pipes shall be fully isolated with full depth, ¼ inch thick, self-expanding cork or other bond-breaking material held securely in place during concrete placement. The annular space at finish floor shall be caulked.

B. Escutcheons - Where uncovered pipe passes through finished walls or ceilings, a chrome plated escutcheon shall be provided.

C. Wall Pipes - Wall pipes shall be provided where called for on the Drawings. Wall pipes shall be provided with a 3 inch high seep ring welded continuous and placed on the center of the pipe. Seep ring shall be ASTM A36 steel, minimum ¼ inch thick. Wall pipe interior shall be finished equal to main line with end connections as required (MJ, Flanged, PE, Push-on Bell).

D. Anchor Bolts - Anchor bolts, nuts, washers, and bolt sleeves shall be Type 316 stainless steel. Expansion bolts shall be "Thunderstuds," as manufactured by Unifast Industries, Inc., Hauppauge, NY, Redhead "Wedge Anchors" as manufactured by ITT Phillips; Michigan City, Indiana or Molly parabolt as manufactured by USM Corporation, Shelton, CT. All expansion bolts and associated hardware shall be stainless steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean and prepare pipe joints to be free of scale, dirt, and debris prior to connections.

3.2 INSTALLATION

A. Work shall be installed in accordance with the manufacturer's printed instructions and shall be plumb and true to line. Install piping as close to walls, and ceilings as possible yet facilitating maintenance and access to valves and devices. In general, piping systems shall parallel walls, partitions, and structural members. Offsets and fittings to accomplish a neat and workmanlike installation shall be provided at no additional cost to the Owner. Piping shall be installed true to the grades required as shown on the Drawings.

B. Take care that stresses are not imposed on the pipe during installation.

C. All valves, fittings, and appurtenances needed on the pipelines shall be set and jointed as indicated on the Drawings or as required.

D. Equipment Connections - Provide unions and control valves on services to equipment provided under other Sections. All valves are to be installed in the upright position. Valves shall be installed and located so they can be operated easily and shall be located adjacent to the equipment.

E. Unions - All piping 2 inches and smaller shall have a sufficient number of unions to allow convenient removal of piping and shall be as approved by the Engineer.

F. Cutting and Patching - Sleeves not initially set in the work shall be cut in place with permission of the Engineer. This work shall be performed by workmen competent to do the work and equipped with proper hand tools. Power tools with the exception of core boring machines shall not be used.

G. Welding - Welding shall only be performed by certified welders tested in the position applicable to the work. Welding shall be performed in accordance with AWS standards. Copies of welding certifications shall be provided to the Engineer.

3.3 REPAIR/RESTORATION

A. During the course of the Work, protect all materials, fixtures, and equipment from damage. Any damage to piping, linings or coatings shall be repaired to the satisfaction of the Engineer or replaced.

3.4 CLEANING

A. At the completion of the Work, thoroughly clean all piping and equipment installed. Remove all concrete, stickers, rust stains, foreign matter and discoloration. Piping and equipment shall be in a thoroughly clean condition and ready for finish painting.

B. All potable water piping shall be thoroughly flushed and disinfected prior to placing in service in a manner approved by the Engineer.

3.5 PRESSURE TESTING

A. Testing - Test all piping systems in accordance with the piping section requirements or to the code applicable to the location where the work is performed. Pipes shall hold pressure without the addition of water or additional pumping. Additional tests or methods may be required by local ordinances or inspection authorities. Tests shall be repeated as necessary to make the systems tight and accepted. Provide all water, air, or gas, apparatus, gauges, and materials necessary for performing tests.

B. Provide all equipment, materials, and apparatus to conduct pressure tests as required by code or the individual piping sections. All tests shall be witnessed by the Engineer. Any leaks shall be repaired and the pipe retested to the Engineer's satisfaction.

C. Test pressure and duration shall be as specified in the individual piping sections.

3.6 DISINFECTION

A. Pipeline disinfection shall be in accordance with Massachusetts State Plumbing Code requirements.

B. All potable water piping shall be thoroughly flushed and disinfected prior to placing in service in a manner approved by the Engineer.

C. Flushing and disinfection procedures are to be submitted to the Engineer for approval for each section of piping.

D. Final flushing

1. Following the chlorination period, flush all treated water from the pipelines at their extremities and replace with water from the public distribution system or previously disinfected piping systems.

2. Flush the piping at as high a velocity as possible. Ensure that the flushing velocity is consistent with the discharge water disposal rate.

3. Dispose of all treated water flushed from the pipes by discharging to the nearest sanitary sewer or by other approved means provided in AWWA C651.

E. Perform flushing in strict conformance with all applicable local, state and Federal regulations. No discharge of chlorinated water to any ground surface, storm drain or natural watercourse will be allowed.

END OF SECTION

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SECTION 15102

CARBON STEEL PIPE AND FITTINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Carbon Steel Pipe and Fittings

B. Related Sections

1. Section 15050 - Piping - General

1.2 REFERENCES

A. ASTM A47 - Specification for Ferritic Malleable Iron Castings

B. ASTM A53 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

C. ASTM A105 - Specification for Forgings, Carbon Steel, for Piping Components

D. ASTM A197 - Specification for Cupola Malleable Iron

E. ASTM A234 - Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

F. ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile

G. ASME B31.3 - Code for Pressure Piping

H. ASME Boiler and Pressure Vessel Code

I. International Mechanical Code (IMC)

1.3 SUBMITTALS

A. Provide submittals in accordance with Section 15050.

1.4 QUALITY ASSURANCE

A. Comply with provisions of Section 15050.

B. Comply with the requirements of ASME Code for Pressure Piping B31.3, Normal Fluid Service.

C. Comply with the requirements of International Mechanical Code

1.5 DELIVERY, STORAGE AND HANDLING

A. Comply with the provisions of Section 15050.

PART 2 PRODUCTS

2.1 CARBON STEEL PIPE AND FITTINGS

A. Steel Pipe - ASTM A-53

1. ½ inch to ¾ inch - Sch. 80

1 inch and larger - Sch. 40

B. Steel Fittings

1. ½ inch to 1½ inch - Screwed Fittings

   2 inch and larger - Buttweld Fittings

2. Screwed Fittings - 300#, ASTM A-47 or A-197

3. Welded Fittings - ASTM A-234 WPB, Seamless

4. Flanges - 150# FF, ASTM A-105, Screwed or Weldneck

5. Unions - ASTM A-105, 3000#

6. Bolting - ASTM A-307, Grade B with X-Heavy Nuts

7. Gaskets - 1/8 inch thick, 150#, spiral wound, 304SS with graphite filler, Flexitaulic Type Co. or 1/16 inch thick composition type

PART 3 EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with Section 15050 and ASME B31.3.

B. The system shall be arranged with low points and drains to permit complete drainage of the system.

3.2 FIELD QUALITY CONTROL

A. Testing shall be in accordance with Section 15050.

B. Water piping shall be tested at 150 psig. Test pressure for other applications will be determined by the Engineer. Test pressure shall be maintained with no loss in pressure for a period of four hours minimum.

END OF SECTION

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SECTION 15700

BASIC HEATING, VENTILATING AND AIR CONDITIONING REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes basic HVAC requirements and general conditions.

B. Contractor to provide VFD's and disconnects for all HVAC equipment as shown in equipment schedules and/or equipment specifications.

C. Related Sections

1. Section 01140 – Work Restrictions

2. Section 01770 - Closeout Procedures

1.2 REFERENCES

A. International Building Code – IBC 2015

B. International Mechanical Code – IMC 2015

C. International Energy Conservation Code – IECC 2018

D. Massachusetts State Building Code, 9th Edition, 780 CMR

1.3 SUBMITTALS

A. Comply with the requirements in Section 01330, Submittal Procedures.

B. Submit manufacturer's drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Submit manufacturer's drawings, bill of material, equipment layouts, catalog data, wiring diagrams and other documentary or descriptive information for each assembly.

E. Provide a schedule of all HVAC system related Owner training. Confirm the date(s) and time(s) with Owner two weeks prior to actual training session(s) and resubmit schedule. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following,

1. Equipment or system to be demonstrated

2. Related specification section

3. Anticipated date of training

4. Anticipated duration of training session

5. Name and company of instructor providing the training

6. Date completed

7. Actual duration of training session

Resubmit schedule upon completion of all training.

1.4 CLOSEOUT PROCEDURES

A. Prior to final acceptance of the Work, provide all closeout documentation in accordance with Section 01770.

1.5 REGULATORY REQUIREMENTS

A. Conform to all codes listed under References in this Section.

B. Conform to all applicable Local Building Codes.

C. Obtain and pay for all applicable permits.

1.6 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Owner's Project Representative before proceeding.

C. Location of heating, ventilation, and air conditioning equipment, piping and ductwork are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is significantly different from that indicated (greater than 5 feet away from location shown on Drawings), the Owner's Project Representative must give approval to the change.

1.7 WORK RESTRICTIONS

A. Refer to section 01140 Work Restrictions, for restrictions during construction.

1.8 DRAWINGS AND SPECIFICATIONS

A. Drawings and specifications are typical of work done and of arrangement desired. Provide all accessories and appurtenances necessary to provide a complete system.

B. Record Drawings: Maintain a master set of record drawings showing the changes and deviations from the contract drawings or the approved shop drawings. Make markups as the changes are made. Submit record documentation to Engineer by substantial completion.

C. Where underground facilities are installed (such as to condensing units), measure, record, and submit final dimensions.

D. The term "Provide" shall mean "To furnish, install, and connect completely".

E. Where the Contractor proposes to use equipment other than that specified in the Contract Documents which requires any redesign of architectural, structural, mechanical, HVAC, plumbing, fire protection, electrical systems or other systems not listed, all redesign efforts and all new drawings and specifications required shall be prepared by the Engineer at the Contractor's expense and are subject to the review and approval of the Owner. Owner reserves the right to have the Architect or Engineer of their choice prepare any redesign work.

1.9 WARRANTY

A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts, and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.

B. During this warranty period, Contractor shall answer all service calls at no expense to the Owner. All defects developing through faulty materials or workmanship shall be corrected or replaced immediately by the Contractor without expense to the Owner. Such repairs or replacements shall be made to the Owner's satisfaction.

C. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.

D. Turn over to the Owner all manufacturer's warranties for equipment and materials provided.

1.1 BASES AND SUPPORTS

A. Unless otherwise specifically noted in the Contract Documents, provide all necessary supports, rails, framing, concrete pads, bases, and piers required for all equipment furnished under this Division.

B. Unless otherwise shown, all equipment shall be securely attached to the building structure in an acceptable manner. Attachments shall be of a strong and durable nature; any attachments that are insufficient, in the opinion of the Engineer, shall be replaced as directed without extra cost to the Owner.

C. All equipment supports shall be designed and constructed such that the equipment will be capable of resisting both vertical and horizontal movement. The equipment shall be positively anchored to the bases or supports to resist vertical movement. The equipment and its supports shall be provided with suitable restraints to resist horizontal movement from any direction as dictated by applicable seismic Codes.

1.2 ACCESSIBILITY AND PANELS

A. Locate all equipment which must be serviced, operated, or maintained in fully accessible positions. Equipment shall include, but not be limited to: motors, fans, actuators, sensors, etc. Access doors shall be furnished if required for better accessibility. Minor deviations from the Drawings may be made to allow better accessibility, but changes of magnitude or which involve extra cost shall not be made without the acceptance of the Engineer.

B. Access doors in walls, ceilings, floors, etc., shall be provided by the General Contractor. Field coordinate locations and provide information regarding the sizes and quantities of access doors required for their work. Arrange work in such a manner to minimize the quantity of access doors required, such as grouping shutoff valves in the same area. Where possible, locate valves in already accessible areas, such as lay-in ceilings, etc.

C. On a clean set of drawings, the Contractor shall mark in red pencil the location of each required access door, including its size and fire rating (if any), and shall submit the print to the Architect for review before access doors are purchased or installed. Upon approval, coordinate access door locations with the General Contractor.

D. Upon completion of the Project, physically demonstrate that all equipment and devices installed have been located and/or provided with adequate access panels for repair, maintenance and/or operation. Any equipment not so furnished shall be relocated or provided with additional access panels at no additional cost to the Owner.

1.3 TEMPORARY OPENINGS

A. The Contractor shall ascertain from an examination of the Drawings whether any special temporary openings in the building will be required for the admission of apparatus provided under this Division and shall coordinate the requirements accordingly. In the event of failure of the Contractor to give sufficient notice in time to arrange for these openings during construction, the Contractor shall assume all costs of providing such openings thereafter.

1.4 QUIET OPERATION

A. Equipment and material used in the various systems described herein shall not produce a sound level greater than 55 decibels in the area served. If noise level is deemed objectionable by the Owner/Engineer, the Contractor shall test and record sound levels in the presence of the Owner/Engineer. The sound level shall be observed on the "A" weighting network of a sound level or sound survey meter. The ASHRAE "Guide and Data Book" provides a means to determine sound level of mechanical equipment when the total of background plus equipment sound levels exceeds the minimum acceptable equipment sound level.

B. If objectionable noises or vibrations of any magnitude are produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of the mechanical work, the Contractor shall make such changes or additions as necessary without extra cost to the Owner.

1.5 LUBRICATION

A. All equipment installed under this Contract having moving parts and requiring lubrication shall be properly lubricated according to manufacturer's recommendations prior to testing and operation. Any such equipment discovered to have been operated before lubrication by the Contractor is subject to rejection and replacement at no additional cost to the Owner. Units furnished with sealed bearings are exempted.

B. Furnish and install, as appropriate on all equipment requiring lubrication, Zerk pressure gun grease fittings or sight gravity-feed oilers equipped with shutoff and needle valve adjustment. Units furnished with sealed bearings and lifetime lubrication are exempted. All fittings and oilers are to be fully accessible for lubrication with equipment which does not require special adapters. Where fittings would be otherwise inaccessible, furnish and install extended grease lines.

1.6 RESTRICTIONS

A. Mechanical equipment provided under this Division may not be used for temporary heating/cooling requirements due to premature wear and dirt/dust infiltration. Written approval may be obtained from the Owner only after submission of a written cleaning plan and guarantee extension.

PART 2 PRODUCTS

2.1 GENERAL

A. Equipment Ampere Interrupting Capacity (AIC) and/or Short Circuit Current Rating (SCCR): HVAC equipment, including but not limited to control panels, VFDs, starters, and disconnect switches furnished by Division 15 shall be labeled in accordance with NFPA 70 and have an AIC or SCCR equal to or greater than the following:

1. 208 or 240 volt equipment: 10,000 amps

B. Requirements for fan motors:

1. Brake horsepower at design conditions shall be less than 80% of rated motor horsepower.

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 15810

DUCTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Metal Ductwork
2. Sealants and Gaskets
3. Hangers and Supports

B. Related Sections

1. Section 15820 - Ductwork Accessories

1.2 REFERENCES

A. ASTM A666 – Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

1.3 SUBMITTALS

A. Product data and installation instructions for materials and products.

B. Scaled layout drawings of ductwork and fittings including but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how these modifications ensure that free area, materials and rigidity are not reduced. Provide a legend defining all abbreviations used.

C. Maintenance data and parts lists for ductwork materials and products.

D. Manufacturer's Installation Instructions: Submit special procedures for glass fiber ducts.

E. Duct Leakage Test Areas: Submit ductwork shop drawing showing locations of duct system as installed. Identify locations of duct leakage testing areas. Refer to Part 3 of this Section for quantity and test location requirements.

F. Duct leakage test and cleanliness inspection reports.

1.4 QUALITY ASSURANCE

A. Manufacturer’s Qualifications - Firms regularly engaged in manufacture of metal products of types, materials, and sizes required, whose products have been satisfactorily used in similar service for not less than 5 years.

B. Installer’s Qualifications - Firm with at least 3 years of successful installation experience on projects with metal systems similar to that required for project.

C. Codes and Standards

1. SMACNA Standards - Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

2. ASHRAE Standards - Comply with ASHRAE Handbook, HVAC Systems and Equipment, Chapter 16 "Duct Construction", for fabrication and installation of ductwork.

3. NFPA Compliance - Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" and NFPA 90B "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

D. Field Reference Manual - Have available for reference at project field office, copy of the following references:

1. SMACNA "HVAC Duct Construction Standards, Metal and Flexible."

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect shop-fabricated and factory-fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclose with waterproof wrapping.

PART 2 PRODUCTS

2.1 METAL DUCTWORK

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Stainless Steel Ducts: Comply with ASTM A 480/A 480M.

1. Type 304 or 316 as indicated in the "Ductwork Schedule"

a. Cold rolled, annealed sheet.

b. Finish: No. 2B finish for concealed ducts and No. 3 finish for exposed ducts.

C. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

D. Tie Rods: Stainless steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 METAL DUCTWORK MATERIALS

A. General - Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with

ductwork system requirements including proper connection of ductwork and equipment.

B. Fittings - Provide radius type fittings fabricated of multiple sections with maximum 15 degree change of direction per section. Unless specifically detailed otherwise, use 45 degree laterals and 45 degree elbows for branch takeoff connections. Where 90 degree branches are indicated, provide conical type tees.

C. Flexible Ducts - Either spiral-wound spring steel with flame-proof vinyl sheathing, or corrugated aluminum; complying with UL 181.

1. Where installed in unconditioned spaces other than return air plenums, provide 2 inch thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

2.3 METAL DUCT FABRICATION

A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Fabricate and support round ducts with longitudinal seams in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible (Round Duct Construction Standards). Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide [airfoil] turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

E. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

F. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

G. Seal joints between duct sections and duct seams with welds, gaskets, mastic adhesives, or mastic plus embedded fabric systems.

1. Sealants and Mastics: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.

2. Tape is not acceptable.

H. Sealing products shall bear UL approval markings.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant
8. Maximum Static-Pressure Class: 10-inch wg positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1) Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.

2) EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

G. Tape type sealants are not acceptable.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods: 316 Stainless Steel, all thread rods.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

D. Steel Cable End Connections: Stainless steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

E. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

F. Trapeze and Riser Supports:

1. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.

G. Beam clamps: Stainless steel with set screw and lock nut. Use jam nut with threaded rod. Spring steel snap-on or hammer-on type are not acceptable.

PART 3 EXECUTION

3.1 INSPECTION

A. General - Examine areas and conditions under which ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 DUCTWORK SCHEDULE:

A. Duct material: All ductwork shall be 316 stainless steel.

B. Static Pressure Class: Unless noted otherwise, construct ducts according to the following:

1. Ducts connected to fan coil units, furnaces, heat pumps, and terminal units:

a. Supply Ducts (Positive Pressure): 1” w.g.

2. Exhaust Ducts (Negative Pressure):

a. Exhaust Ducts: 2” w.g.

3.3 INSTALLATION OF DUCTWORK

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

D. Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3 inches w.c. and under) and

noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connection, within 1/2 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

E. Support design and installation shall be in accordance with applicable Massachusetts Building Codes.

F. Field Fabrication - Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.

G. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system

H. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations, or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment.

I. Install ducts close to walls, overhead construction, and other structural and permanent enclose elements of building.

J. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

K. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

L. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

M. Coordination - Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

N. Ductwork Insulation – Insulate ductwork in accordance with Section 15080.

3.4 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.5 EQUIPMENT CONNECTIONS

A. General - Connect ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated, or as required to provide access for cleaning ducts.

3.6 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. All ducts shall be “Seal Class A”.

3.7 HANGERS AND SUPPORTS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used

3.8 FIELD QUALITY CONTROL

A. Visually inspect duct system to ensure that no visible contaminants are present

B. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of

metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.

C. Provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris at ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation.

D. Seal any leaks in ductwork that become apparent in balancing process.

E. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

1. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

F. Duct system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

3.9 LEAKAGE TESTING

A. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.

B. Test the following systems:

1. Supply, return, exhaust and outdoor air ducts with a Pressure Class Higher Than 2-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.

2. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

3. Test for leaks before applying external insulation.

4. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

5. Give seven days' advance notice to Owner and Engineer for testing.

3.10 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer.

2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.

3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.

2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).

2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.

3. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.

2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.

4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.

5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

6. Provide drainage and cleanup for wash-down procedures.

7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris

END OF SECTION

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SECTION 15820

DUCTWORK ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Duct hardware

2. Flexible connections

B. Related Sections

1. Section 15810 - Ducts

1.2 QUALITY ASSURANCE

A. Manufacturers' Qualifications - Firms regularly engaged in the manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Code and Standards:

1. SMACNA Standards - Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" for fabrication and installation of metal ductwork.

2. Industry Standards - Comply with ASHRAE recommendations pertaining to construction of ductwork, accessories, except as otherwise indicated.

3. NFPA Compliance - Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories.

1.3 SUBMITTALS

A. Technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions.

B. Assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.

C. Manufacturer's maintenance data including parts lists for each type of duct accessory.

PART 2 PRODUCTS

2.1 DUCT HARDWARE

A. General - Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test Holes - Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.

2. Quadrant Locks - Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 inches.

Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer - Subject to compliance with requirements, provide duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.
3. United Sheet Metal
4. Or equal

2.2 FLEXIBLE CONNECTORS

A. General - Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: provide flexible connectors with a factory fabricated fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

F. Manufacturer - Subject to compliance with requirements, provide flexible connections of one of the following:

1. American/Elgen Co., Energy Div.
2. Duro Dyne Corp.
3. Flexaust (The) Co.
4. Ventfabrics, Inc.
5. Or equal

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

B. Flexible ducts shall only be used to connect rigid ducts to equipment and shall not exceed three feet in length.

C. Provide test holes at fan inlets and outlets and elsewhere as required for testing and balancing purposes.

D. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 FIELD QUALITY CONTROL

A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

A. Cleaning - Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

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SECTION 15835

HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Propeller Wall Fans

2. Square Inline Fans

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of fans, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Codes and Standards

1. AMCA Compliance - Provide fans bearing the AMCA Certified Ratings Seal. Sound rate fans in accordance with AMCA 300 "Test Code for Sound Rating Air Moving Devices".

2. ASHRAE Compliance - Test and rate fans in accordance with ASHRAE 51 (AMCA 210) "Laboratory Methods of Testing Fans for Rating".

3. UL Compliance - Provide fan electrical components which have been listed and labeled by UL 705.

1.3 SUBMITTALS

A. Manufacturer's technical product data for fans, including AMCA certified rating seal for sound and air performance, specifications, capacity ratings, flow rate, external static pressure, fan performance curves with operating point clearly indicated, bearing life, gauges and finishes of materials.

B. Provide outlet velocity and fan's inlet sound power readings for the eight octave bands, decibels, and sones.

C. Assembly-type shop drawings showing fan dimensions, required clearances, construction details including material gages and finishes, and field connection details.

D. Manufacturer's electrical requirements for power supply wiring to fan units. Provide manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

E. Close out submittal: Operation and maintenance instructions, including lubrication instructions, motor and drive replacement, and spare parts lists. Include this data, product data, approved shop drawings, and wiring diagrams with maintenance manuals.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans with factory-installed shipping skids and lift lugs; pack components in factory-fabricated protective containers.

B. Handle fans carefully to avoid damage to components, enclosures, and finish. Do not install damaged components; replace and return damaged components to fan manufacturer.

C. Store fans in clean dry place and protect from weather and construction traffic.

D. Comply with manufacturer's rigging and installation instructions for unloading fans, and moving them to final location.

1.5 WARRANTY

A. Furnish one year manufacturer’s warranty for fans and accessories.

1.6 EXTRA MATERIALS

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Fans

1. Greenheck Corp.

2. Loren Cook Company.

3. Twin City Fan and Blower.

4. Or equal

2.2 PROPELLER WALL FANS

A. General - Provide propeller wall fans of sizes, drive type and arrangement as indicated, and of capacities and having accessories as scheduled. All fans shall be AMCA certified and licensed to bear the AMCA seal.

B. Construction:

1. Impeller: cast aluminum blade with hubs, statically and dynamically balanced, keyed and locked to shaft, directly connected to motor or furnished with V-belt drive.

2. Frame: One piece, square steel with die formed venturi orifice, mounting flanges and supports, with baked enamel finish.

3. Shaft & Bearings: Fan Shaft shall be ground and polished solid steel with an anti corrosive coating. Bearing shall be cast iron pillow block with grease fittings. Bearings shall be selected for a minimum L10 life in excess of 100,000 hours, at maximum cataloged operating speed. Fan Shaft first critical speed is at least 25 percent over maximum operating speed.

4. Coating: Exhaust fans: Epoxy powder coating.

C. Accessories:

1. Safety Screens: Expanded stainless steel metal over inlet, motor, and drive ; to comply with OSHA regulations.

2. Wall housing – Painted steel housing, coated protective guards to mount fan and other accessories.

3. Unit mounted fan speed controller for direct drive fans. Do not locate speed controller in Class 1 areas.

4. Provide additional accessories as noted on drawings.

5. Disconnect switch: NEMA 3, Lockable – indoor applications.

D. Provide the following accessories as indicated in the equipment schedules:

1. Coating: Phenolic epoxy powder coating

E. Motors: In accordance with Section 16220. Type: TEFC, permanently lubricated, heavy duty ball bearing type to match with the fan load and furnished at the specific voltage and phase.

2.3 SQUARE IN-LINE CENTRIFUGAL FANS

A. General – Provide in-line centrifugal fans of sizes and arrangement as indicated and or capacities and having accessories as scheduled. The units shall be of aluminum construction, including propellers, rivets and other hardware. All fans shall be AMCA certified and licensed to bear the AMCA seal for all applicable AMCA ratings noted below.

B. Construction:

1. Housing – Aluminum housing, bolted access door with neoprene gasketing, support bracket adaptable to floor, horizontal or vertical mount installation.

2. Wheel – Centrifugal backward inclined, aluminum, cast aluminum hub. Balanced according to AMCA 204-05.

C. Motors – Motors shall be out of the air stream. Each direct drive unit shall be prewired to an external twist lock disconnect located on the outside of the fan housing. Each belt drive unit shall have the motor externally mounted with adjustable sheave and base. Belt drive units with 2 speeds shall have double wound motors capable of providing 50% and 100% of air quantities as scheduled. Each fan shall be interlocked with corresponding motorized damper in the intake duct as shown on Drawings. Belts shall be in anodized aluminum tunnels. The motors shall have standard NEMA frame sizes and shall be TENV or TEFC if available; otherwise provide manufacturer's standard motor. Single phase units shall have built-in thermal overload protectors. Motors shall meet the requirements of Section 16220.

D. Disconnect Switch: Factory wired and mounted, non-fusible, in housing for thermal overload protected motor, NEMA type as noted below,

a. NEMA 3, Lockable – indoor applications.

A. Provide the following accessories for all fans:

1. Companion Flanges – Provide matching flanges on inlet and outlet to connect ductwork to fan

2. Safety Screen – ½"x½" galvanized, welded wire, with baked polyester coating, factory installed. Provide on non-ducted installations.

3. Vibration Control – Provide spring floor isolator or hanger, with number and size of isolators selected by manufacturer.

B. Provide the following accessories as indicated in the equipment schedules:

1. Coating: Phenolic epoxy powder coating

2. Inlet flex duct connector.

2.4 EXTRA MATERIALS

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to the Engineer and Owner.

3.2 INSTALLATION OF FANS

A. General - Install fans where indicated, in accordance with manufacturer's installation instructions, and with recognized industry practices, to ensure that fans comply with requirements and serve intended purposes.

B. Access - Provide access and service space around and over fans as indicated, but in no case less than that recommended by manufacturer.

C. Isolation - Set fans on vibration isolators, fasten in accordance with manufacturer's installation instructions.

D. Electrical Wiring - Install electrical devices furnished by manufacturer but not specified to be factory-mounted.

1. Electrical wiring installation shall be in accordance with manufacturer's submittal and installation requirements of Division 16 sections. Ensure that rotation is in direction indicated.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of fans, and after motor has been energized with normal power source, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected. All testing and necessary equipment replacement shall be done at no additional cost to the Owner.

3.4 ADJUSTING, BALANCING AND CLEANING

A. Start-up, test, and adjust fans in presence of manufacturer's authorized representative

B. Provide additional belts and sheaves required to adjust the fan airflow rate in the field.

C. Balance fan to achieve the design airflow rate.

END OF SECTION

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SECTION 15850

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Stationary Louvers

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications - Firms regularly engaged in manufacture of air outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years.

B. Codes and Standards

1. ARI Compliance - Test and rate air outlets and inlets in accordance with ARI 650 "Standard for Air Outlets and Inlets".

2. ASHRAE Compliance - Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".

3. ADC Compliance - Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".

4. ADC Seal - Provide air outlets and inlets bearing ADC Certified Rating Seal.

5. AMCA Compliance - Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".

6. AMCA Seal - Provide louvers bearing AMCA Certified Rating Seal.

7. NDPA Compliance - Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

A. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.

B. Data sheets for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, mounting details and warranty.

C. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings. Indicate selections on data.

D. Manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.

E. Maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver air outlets and inlets wrapped in factory-fabricated fiber-board type containers. Identify on outside of container type of outlet or inlet and location to be installed. Avoid crushing or bending and prevent dirt and debris from entering and settling in devices.

B. Store air outlets and inlets in original cartons and protect from weather and construction work traffic. Where possible, store indoors; when necessary to store outdoors, store above grade and enclose with waterproof wrapping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Louvers

1. Construction Specialties, Inc.
2. Greenheck
3. Louvers & Dampers, Inc.
4. Ruskin Company
5. Or equal

2.2 STATIONARY LOUVERS

A. General - Except as otherwise indicated, provide louvers of size, shape, capacity and type indicated; constructed of materials and components as indicated.

B. Performance - Provide louvers that have minimum free area, and maximum pressure drop of each type as listed in manufacturer's current data, complying with louver schedule.

C. Fabrication:

1. Performance Ratings: AMCA licensed.
2. Frame:
   a. Material: Extruded aluminum, Alloy 6063-T5 or T6.
   b. Wall Thickness: 0.081 inch, nominal.
   c. Depth: Refer to model number on Louver Schedule.
   d. Downspouts and caulking surfaces.
3. Blades:
   a. Style: Drainable.
   b. Material: Extruded aluminum, Alloy 6063-T5.
   c. Wall Thickness: 0.081 inch, nominal.
   d. Angle: 37.5 degrees.
   e. Centers: 5-3/32 inches, nominal.
4. Bird Screen:
   a. Material: Aluminum, 1/2 inch mesh x 0.063 inch.

b. Frame: Removable, rewireable.

5. Gutters: Drain gutter in head frame and each blade.

6. Downspouts: Downspouts in jambs to drain water from louver for minimum water cascade from blade to blade.

7. Vertical Supports: Hidden vertical supports to allow continuous line appearance up to 120 inches (3,048 mm).

8. Sill: Steeply angled integral sill eliminating areas of standing or trapped moisture where mold or mildew may thrive and effect indoor air quality.

9. Assembly: Factory assemble louver components. All welded construction.

D. Performance Data

1. Refer to Louver Schedule on drawings.
2. Maximum Pressure Drop: 0.15 inches w.g.
3. Water Penetration: Maximum of 0.01 ounces per square foot of free area at an air flow of 873 feet per minute free area velocity when tested for 15 minutes.
4. Design Load: Incorporate structural supports required to withstand wind load of 20 pounds per square foot.

E. Factory Finish

1. Kynar 500 Fluoropolymer Coating (70% PVDF)

a. Conform to AAMA 605.2.

b. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.

c. Warranty: Minimum 10 years.

2. Color: Match color of building exterior. Verify final color selection with owner.

F. Accessories

1. Insect screen where indicated on Louver Schedule.

2. Provide extended sill when louver is recessed in from face of exterior wall surface.

3. Installation angles and fasteners. Coordinate size of angles to properly install louver in specified wall construction on architectural or structural drawings.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which air outlets and inlets are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General - Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that products serve intended function.

B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

END OF SECTION

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SECTION 15935

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. General Requirements

1. Provide all materials, engineering, and labor for the proper installation of a complete and operational control system.

2. Provide control systems consisting of thermostats, control valves, dampers and operators, indicating devices, interface equipment and other apparatus and accessories to operate mechanical systems, and to perform functions specified in the Contract Documents.

3. Provide 120 volt power for all HVAC control panels and devices requiring 120 volts from electrical power panels. Spare circuit breakers will be provided in electrical power panels as part of the Division 16 Work. Coordinate with the Division 16 Contractor and Electrical Engineer to determine the location of the 120 volt power source(s).

4. Step down the 120 volt power and provide 24 volts or less for all control devices, unless control devices require 120 volt power per the Contract Documents.

5. Install and wire all loose control devices provided with HVAC equipment, i.e. fan EC motor controllers, wall mounted speed switches, etc.

6. Provide all electrical components in accordance with Division 16 requirements, including but not limited to conductors, cables, conduit, hangers and supports, identification, boxes, and enclosures.

B. Section Includes

1. Thermostats

2. Control Panels

3. Control wiring between field-installed controls, indicating devices, and unit control panels

4. Interlock wiring specified as factory-installed

C. Related Sections

1. Section 15940 – Sequence of Operation

2. Division 16 – Electrical

1.2 REFERENCES

A. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

B. Underwriters Laboratories, Inc.:

1. Provide electrical products which have been tested, listed and labeled by Underwriters Laboratories, Inc.

1.3 QUALITY ASSURANCE

A. Manufacturer's Qualifications -

1. Firms regularly engaged in manufacture of electric control equipment, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.

2. Location of manufacturer’s approved service facilities, located within 50 miles of the project.

B. The Control Systems Contractor Qualifications - Firms specializing and experienced in electrical control system installations for not less than 5 years.

1.4 SUBMITTALS

A. Manufacturer's technical product data for each control device, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials, and including installation instructions and start-up instructions.

B. Shop drawings for each electric control system, containing the following information.

1. Schematic flow diagram of system showing fans, dampers, and control devices.

2. Label each control device with setting or adjustable range of control.

3. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

4. Provide details of faces of control panels, including controls instruments, and labeling.

5. Include description of sequence of operation.

C. Provide point schedule for each controller. Include point description, system served, location of device being controlled, device product information.

D. Submit a list of all spaces requiring temperature sensors and thermostats and identify the model of sensor and/or thermostat provided for each room.

E. Product Data: Submit description and engineering data for each control system component, including sensitivity ranges, means of adjustment and calibration, its function and application. Include sizing as required.

F. Maintenance instructions and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals.

G. Submit circuit coordination information for review by Engineer and Contractor, indicating electrical circuit requirements, loads, etc for control system. Provide copy of final electrical circuit requirements to Division 16 Contractor for use in preparing electrical panels serving controls system.

H. Submit software manual to Owner. Manual shall include:

1. Overview of system and a description of each feature.

2. Operational instructions including verifying status and errors, changing passwords, and initiating or disabling control programs/sequences.

3. Description of programming language including commands, algorithms, system printouts and logs.

4. Documentation necessary for Owner to interpret program and make desired changes.

5. Instructions for user programming any portion of the control system including algorithms, variables, setpoints, time periods, equations and other user adjustable settings.

1.5 COORDINATION

A. Coordinate location of thermostats, switches, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other divisions including to achieve compatibility with equipment that interfaces with those systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Provide factory shipping cartons for each piece of equipment and control device. Maintain cartons through shipping, storage and handling as required to prevent equipment damage, and to eliminate dirt and moisture from equipment. Store equipment and materials inside, protected from weather.

B. Upon completion of project, submit for review electronic control shop drawings corrected for as-built conditions. Include final pressure settings, spring ranges, temperature ranges, throttling ranges and temperature control settings. Three copies of accepted “record” shop drawings shall be provided to Owner.

1.7 WARRANTY

A. Provide one year manufacturer warranty for materials and labor.

B. Provide necessary service to adjust and check the control system, at no additional cost to the Owner, during the one year warranty.

1. This shall include service required to correct space temperature alarms and equipment control problems which are the result of malfunction of control equipment.

C. This shall include full system checkout and calibration.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer - Subject to compliance with requirements, provide electric control systems of one of the following:

1. General:

a. Honeywell, Inc.

b. Johnson Controls

c. Siemens Building Technologies, Inc.

d. Or equal

2. Smart Thermostats:

a. Nest

b. Ecobee

c. Emerson Sensi

d. Or equal

2.2 GENERAL

A. Provide manufacturer's standard control system components as indicated by published product information, designed and constructed as recommended by manufacturer. Provide control systems with following functional and construction features as indicated.

B. Contract Drawings do not show every control device. Specifications shall be the primary source of control requirements and unless specifically stated, every piece of heating and cooling equipment shown on Contract Drawings requires control through local controls.

C. Control system shall be complete, to provide a fully functional system, including, but not limited to:

1. Room, insert and immersion thermostats and sensors.

2. Control Dampers.

3. Control Panels.

4. Transmission power supply.

5. Control wiring and conduit.

6. Auxiliary devices and accessories.

7. Building communication network interface and associated software.

D. Provide 120 V power wiring to ATC control panels, 24 volt control wiring to control devices, and conduit, junction boxes, relays, transformers, fittings and other electrical appurtenances that are required for complete and operational control and monitoring systems. Conform to electrical standards, codes and requirements specified under Division 16. This work shall include, but not be limited to:

1. Power wiring of ATC temperature control panels carrying voltages up to and including 120 V.

2. Wiring of 24 V from temperature control CPUs to digital controllers, switches, sensors, thermostats, and other control system equipment and devices.

3. Wiring of devices controlled as part of the work of this Division.

4. Wiring of devices providing control inputs. Examples include smoke detector contact; fire alarm relay contact; pressure, temperature, limit level and motion switches.

5. Wiring from temperature control panel to terminal strips.

6. Wiring between panel terminal strips and field mounted devices.

A. Electrical Conduit and Tubing:

1. Refer to specification 16131 for all conduit, tubing, and fitting material requirements.

2. Exposed wiring is not permitted.

3. Applications:

a. 120 volt power wiring: Refer to specification 16131 for all application requirements for conduit, tubing, and fittings.

b. 24 volt HVAC control wiring:

1) Indoor exposed conduit: Electrical metallic tubing

2) All other applications: Electrical metallic tubing

4. Refer to specification 16131 and 16070 for all conduit supports requirements. Refer to specification 16136 for all electrical box requirements.

B. Power wiring installed and terminated as part of the DIVISION 16, shall include,

1. Wiring of devices and circuits carrying voltages 120 volts or greater, unless otherwise indicated.

2. Wiring of power feeds to disconnects, starters, VFDs and electric motors.

C. Transmission Network

1. System shall have mulitdrop digital transmission network that provides a communication link between operator's terminal and all DDC panels.

2. System shall have error checking feature to ensure signal reliability and shall identify signal transmission network failures. System shall ensure signal quality and strength and support mulit-drop trunks.

3. Wiring shall NOT be run in same conduit with fire alarm, security, lighting, building power or other dedicated systems.

2.3 THERMOSTATS

A. Low Voltage Thermostat:

1. Wi-fi networked smart thermostat.

2. User-configurable high and low temperature alarms.

3. Power: 24 Vac with battery backup.

4. Service: Cooling only, heating only, or cooling and heating.

5. Covers: Locking with set point adjustment.

6. Display: Large, clear display with backlight and real-time clock.

7. Operating ambient temperatures: 0˚F to 120˚F.

8. Humidity Rating: 5% to 90% RH.

9. Setpoint Range:

a. Cooling: 50˚F to 99˚F.

b. Heating: 40˚F to 90˚F.

10. Changeover: Auto or manual, selectable. Set to auto.

11. Programmable:

a. Seven day with holidays.

b. Two occupied and two unoccupied daily settings.

B. Room Thermostat Accessories:

1. Insulating Bases: For thermostats located on exterior walls.

2.4 CONTROL PANELS

A. Provide for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, push buttons and switches flush on cabinet panel face. All lights shall be LED.s

B. Construction: Refer to Division 16.

C. Covers: Continuous hinge, held closed by flush latch operable by screwdriver or key (common key for all panels).

D. Enclosure Finish: Manufacturer's standard enamel.

E. Master control panel shall have multi-color graphic displays, schematically showing system being controlled.

F. Provide spare dry form C alarm contacts.

2.5 HAND-OFF-AUTO (HOA) SWITCHES

A. Provide remote hand-off-auto switches where indicated on drawings. In general, remote hand-off-auto switches are indicated where the control panel is in a separate room from the controlled equipment.

B. Construction and components: In accordance to Division 16,

2.6 ELECTRICAL CHARACTERISTICS AND COMPONENTS

A. Conform to electrical requirements in Division 16 specifications.

B. Disconnect Switch: Factory mount disconnect switch on control panels.

PART 3 EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which electric control systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Engineer.

3.2 INSTALLATION OF ELECTRIC CONTROL SYSTEMS

A. General - Install systems and materials in accordance with manufacturer's instructions and roughed-in drawings, and details on drawings. Install electrical components and use electrical products complying with requirements of applicable Division 16 sections of these specifications. Mount controllers at convenient locations and heights.

B. Control Wiring - The term "control wiring" is defined to include providing wire as per Section 16120, conduit as per Section 16131 and miscellaneous materials as required for mounting and connecting electric control devices.

C. Wiring System - Install complete control wiring system for electric control systems. Conceal wiring except in mechanical rooms and areas where other conduit and piping are exposed. Provide multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along a common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly.

D. Number-code and color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system.

E. Reset Limit Controls - Install manual-reset limit controls to be independent of power controllers; automatic duct heater resets may, at Contractor's option, be installed in interlock circuit of power controllers.

F. Unit-Mounted Equipment - Where control devices are indicated to be unit-mounted, ship electric relays, electric switches, valves, dampers, and damper motors to unit manufacture for mounting and wiring at factory.

G. Room thermostats and wall mounted sensors:

1. Install in locations as indicated on the drawings and to meet the intent of the sequence of operations.

2. Mount 48” above finished floor.

3.3 ADJUSTING AND CLEANING

A. Start-Up - Start-up, test, and adjust electric control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning - Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment - After completion of installation, adjust thermostats, control valves, motors and similar equipment provided as work of this Section.

3.4 CLOSEOUT PROCEDURES

A. Owner's Instructions - Provide services of manufacturer's technical representative for one 8-hour day to instruct Owner's personnel in operation and maintenance of electric control systems.

1. Schedule instruction with Owner, provide at least 7-day notice to Contractor and Engineer of training date.

END OF SECTION

SECTION 15940

HVAC SEQUENCE OF OPERATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes sequences for HVAC systems and equipment. All control devices, components, wiring, etc. shall be provided to execute the sequence of operations listed in the Contract Documents.

B. Operating equipment, devices, and system components required for control systems are specified in other Division 15 sections of these Specifications.

C. Coordinate with Section 15950 - Testing, Adjusting, and Balancing to test and balance equipment at each setpoint specified for each sequence of operation.

D. Section Includes

1. Operating sequence for HVAC equipment and systems

2. Operating equipment, devices, and system components required for control systems are specified in other Division 15 sections of these Specifications.

E. Related Sections

1. Section 15935 – Instrumentation and Control for HVAC

2. Section 15950 – Testing, Adjusting and Balancing

3. Division 16 – Electrical

1.2 SUBMITTALS

A. Shop Drawings - Submit shop drawings for each system automatically controlled, containing the following information:

1. Label with settings, adjustable range of control and limits. Submit written description of control sequence.

2. Submit flow diagrams for each control system, graphically depicting control logic.

3. Submit draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

4. Indicate conduit, factory and field wiring.

5. Indicate each control panel required, with internal and external conduit and wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling.

B. Closeout Submittals

1. Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

PART 2 PRODUCTS

2.1 COMPONENTS

A. Provide all control components necessary to operate the equipment as specified herein. All controls shall be electric or self-contained. Refer to entire specification for additional components and sequences. Control components to include dampers, control valves, thermostats/temperature sensors, actuators, sensors, switches, wiring and conduit.

B. Provide control panels containing the switches, lights for monitored points, alarm lights, etc. for all equipment.

PART 3 EXECUTION

3.1 GENERAL

A. Electrical equipment, wiring, conduit and controls shall conform to the requirements of the Division 16 specifications.

B. Provide controls, including wiring for the HVAC equipment in accordance with the following sequences of operation.

3.2 MODES AND TEMPERATURE SETTING

A. Verify all setpoints, time schedules, and modes listed below with owner. Some spaces may require the occupied mode set 24 hours/day, 7 days/week.

B. Compressor Shed:

1. Cooling setpoint: 85˚F.

3.3 SEQUENCE OF OPERATION – COMPRESSOR SHED EXHAUST FAN

A. Overview: The system consists of an outside air intake louver and exhaust fan with a. A hand-off-auto (HOA) switch and a wall mounted thermostat controls the operation of the exhaust fan.

B. HOA switch in “Auto” position:

1. If space temperature rises above the setpoint exhaust fan shall run.

2. If space temperature falls below setpoint the fan shall cycle off.

C. HOA switch in “Hand” position:

1. Exhaust fan shall run.

D. HOA switch in “Off” position:

1. Exhaust fan shall turn off.

E. Alarms:

1. Configure networked thermostat to generate an alarm when the temperature in the space rises above 100°F.

2. Assist Owner in configuring an account for the thermostat.

END OF SECTION

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SECTION 15950

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes, but not limited to:

1. Balancing Air Systems.

2. Testing, Adjusting, and Balancing Equipment:

a. Fans

3. Duct leakage tests.

4. Measuring electrical performance of HVAC equipment.

B. Related Sections:

1. Section 15940 – HVAC Sequence of Operations

1.2 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. BAS: Building automation systems.

C. NEBB: National Environmental Balancing Bureau.

D. TAB: Testing, adjusting, and balancing.

E. TABB: Testing, Adjusting, and Balancing Bureau.

F. TAB Specialist: An independent entity meeting qualifications to perform TAB work.

G. TDH: Total dynamic head.

H. Adjust - To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).

I. Balance - To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.

J. Branch - Duct or pipe serving a single terminal.

K. Branch Main - Duct or pipe serving two or more terminals.

L. Main - duct or pipe containing the system's major or entire fluid flow.

M. Procedure - Standardized approach and execution of sequence of work operations to yield reproducible results.

N. Report forms - Test data sheets arranged for collecting test data in logical order for submission and review. These data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.

O. Submain - Duct or pipe containing part of the systems' capacity and serving two or more branch mains.

P. Test - To determine quantitative performance of equipment.

Q. Terminal - The point where the air enters or leaves the distribution system. Examples are air supply diffusers and air return grilles.

1.3 SUBMITTALS

A. Qualification Data: Submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Strategies and Procedures Plan: Submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

C. Deficiency reports.

D. Certified TAB reports.

E. Floor plans with all test locations circled in bold red marker. Note duct and piping sizes on the floor plans if they differ from the design drawings.

F. Floor plans noting where balancing devices (dampers, valves, etc.) are not installed per the contract documents. Refer to HVAC details for balancing device locations.

G. Instrument calibration reports, to include the following:

1. Instrument type and make.

2. Serial number.

3. Application.

4. Dates of use.

5. Dates of calibration.

1.4 QUALITY ASSURANCE

A. Installing contractor may not test and balance their own work. An independent TAB Contractor is required.

B. TAB Specialists Qualifications: Certified by AABC, NEBB or TABB.

1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC, NEBB or TAB.

2. TAB Technician: Employee of the TAB specialist and certified by AABC, NEBB or TABB as a TAB technician.

C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."

1.5 FIELD CONDITIONS

A. Full or Partial Owner Occupancy: Owner may occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 PRODUCTS (NOT APPLICABLE)

PART 3 EXECUTION

3.1 GENERAL

A. Test and balance all sequences of operation and operating conditions specified in the sequences of operation for all equipment. Coordinate with the HVAC system controls contractor for this effort.

3.2 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.

B. Examine installed systems to observe if the installed systems may create adverse effects on airflow flow performance. Submit observation Deficiency Report to Engineer and Owner. Do not begin testing, adjusting, and balancing of any systems until deficiencies have been remedied.

C. Examine installed systems for balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are applicable for intended purpose and are accessible. If there are inadequate devices or are not easily accessible, notify project Engineer in writing.

D. Examine the approved submittals to obtain flow rates and balancing values for HVAC systems and equipment.

E. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems output, statements of philosophies and assumptions about HVAC system and equipment controls, and sequences of operations.

F. Examine equipment performance data including fan and pump curves.

1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

a. Document locations in systems where system effects may cause undesired conditions. Submit locations to project Engineer.

2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

H. Examine test reports specified in individual system and equipment Sections.

I. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.

J. Examine operating safety interlocks and controls on HVAC equipment.

K. Report deficiencies discovered before and during performance of TAB procedures to project Engineer. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values. Report if no deficiencies are discovered.

3.3 PREPARATION

A. Prepare a complete TAB plan that includes the following:

1. Equipment and systems to be tested.

2. All sequences to be tested.

3. Strategies and step-by-step procedures for balancing the systems.

a. Note minimum and maximum duct traverse test points and test point distance spacing for varying duct sizes.

4. Instrumentation to be used.

5. Sample forms with specific identification for all equipment.

B. Perform system-readiness checks of HVAC systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:

1. Airside:

a. Leakage and pressure tests on air distribution systems have been satisfactorily completed.

b. Duct systems are complete with terminals installed.

c. Fans are operating, free of vibration, and rotating in correct direction.

d. Variable-frequency controllers' startup is complete and safeties are verified.

e. Windows and doors are installed. All windows shall be shut and locked. All exterior doors shall be shut, with only normal traffic in and out. All interior doors in rooms served by systems being tested shall be closed and remain closed for the duration of the test.

f. Suitable access to balancing devices and equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Total System Balance"

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.

1. After testing and balancing, patch and seal probe holes in ducts with same material and thickness as used to construct ducts.

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross-check the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

D. Check airflow patterns from the outdoor-air and through the supply-fan discharge.

E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check for airflow blockages.

H. Verify that air duct system is sealed as specified in the “Ducts" specification.

I. Adjust VFDs or change fan and motor sheaves, pulleys and belts to properly balance the system.

3.6 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. The procedures in this article apply to constant volume supply, return, and exhaust air systems.

B. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure total airflow.

a. Where duct conditions allow, measure airflow by Pitot-tube traverse. If necessary, perform multiple Pitot-tube traverses to obtain total airflow.

b. Where duct conditions are not suitable for Pitot-tube traverse measurements, a coil traverse may be acceptable.

c. If a reliable Pitot-tube traverse or coil traverse is not possible, measure airflow at terminals and calculate the total airflow.

2. Measure fan static pressures as follows:

a. Measure static pressure directly at the fan outlet or through the flexible connection.

b. Measure static pressure directly at the fan inlet or through the flexible connection.

c. Measure static pressure across each component that makes up the air-handling system.

d. Measure outlet static pressure as far downstream from the fan as practicable, at least three-quarters of the way down the system.

e. Report artificial loading of filters at the time static pressures are measured.

3. Obtain approval from Engineer or Owner for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.

4. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload occurs. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

C. Verify final system conditions.

1. Re-measure and confirm that total airflow is within design.

2. Re-measure all final fan operating data, rpms, volts, amps, and static profile.

3. Mark all final settings.

4. Measure and record all operating data.

5. Record final fan-performance data.

3.7 CONTROLS VERIFICATION

A. In conjunction with system balancing, perform the following:

1. Verify temperature control system is operating within the design limitations.

2. Confirm that the sequences of operation are in compliance with Contract Documents.

3. Verify that controllers are calibrated and function as intended.

4. Verify that controller set points are as indicated.

5. Verify the operation of lockout or interlock systems.

6. Verify the operation of valve and damper actuators.

7. Verify that controlled devices are properly installed and connected to correct controller.

8. Verify that controlled devices travel freely and are in position indicated by controller: open, closed, or modulating.

9. Verify location and installation of sensors to ensure that they sense only intended temperature, humidity, or pressure.

B. Reporting: Include a summary of verifications performed, remaining deficiencies, and variations from indicated conditions. Report airflows for all sequences.

3.8 TOLERANCES

A. Set HVAC system's airflow rates and water flow rates within the following tolerances:

1. Air Systems:

a. Exhaust Fans: 0 to +10 percent.

b. Air Outlets and Inlets: +/- 10 percent.

B. Maintaining pressure relationships as designed shall have priority over the tolerances specified above.

3.9 FINAL REPORT

A. General: Prepare a certified computer written report; tabulate and divide the report into separate sections for tested systems and balanced systems.

1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.

2. Include a list of instruments used for procedures, along with proof of calibration.

3. Certify validity and accuracy of field data.

B. Final Report Contents: In addition to certified field-report data, include the following:

1. Fan curves.

2. Manufacturers' test data.

3. Field test reports prepared by system and equipment installers.

4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.

C. General Report Data: In addition to form titles and entries, include the following data:

1. Title page.

2. Name and address of the TAB specialist.

3. Project name.

4. Project location.

5. Engineer's name and address.

6. Contractor's name and address.

7. Report date.

8. Signature of TAB supervisor who certifies the report.

9. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

10. Summary of contents including the following:

a. Design versus final performance. Design values shall be recorded from the approved equipment submittals.

b. Notable characteristics of systems, including suspect duct, piping, and equipment installations causing high system pressure drop.

c. Description of system operation sequence if it varies from the Contract Documents.

11. Nomenclature sheets for each item of equipment.

12. Data for terminal units, including manufacturer's name, type, size, and fittings.

13. Notes to explain why certain final data in the body of reports vary from indicated values.

14. Test conditions for fans and pump performance forms including the following:

    a. Settings for outdoor and exhaust-air dampers.

    b. Fan drive settings including settings and percentage of maximum pitch diameter.

    c. Settings for supply-air, static-pressure controller.

    d. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outdoor and exhaust airflows.

2. Duct, outlet, and inlet sizes.

E. Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:

1. Report Data:

    a. Unit number.

    b. Location and zone. Note location on floor plans.

    c. Traverse air temperature in deg F.

    d. Quantity of traverse reading points for each test location.

    e. Duct static pressure in inches wg.

    f. Duct size in inches.

    g. Duct area in sq. ft.

    h. Indicated airflow rate in cfm.

    i. Indicated velocity in fpm.

    j. Actual airflow rate in cfm.

    k. Actual average velocity in fpm.

    l. Barometric pressure in psig.

F. Air-Terminal-Device Reports:

1. Unit Data:

    a. Unit identification.

    b. Location and zone.

    c. Apparatus used for test.

    d. Area served.

    e. Make.

f. Number from system diagram.

g. Type and model number.

h. Size.

i. Effective area in sq. ft.

2. Test Data (Designed and Actual Values):

a. Airflow rate in cfm.

b. Air velocity in fpm.

c. Preliminary airflow rate as needed in cfm.

d. Preliminary velocity as needed in fpm.

e. Final airflow rate in cfm.

f. Final velocity in fpm.

g. Space temperature in deg F.

3.10 VERIFICATION OF TAB REPORT

A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Owner, Architect, Engineer, Construction Manager, or commissioning authority.

B. Owner, Architect, Engineer, Construction Manager, or Commissioning authority will randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.

C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."

D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

E. If TAB work fails, proceed as follows:

1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.

2. If the second final inspection also fails, Owner may contract the services of another TAB specialist to complete TAB work according to the Contract Documents and deduct the cost of the services from the original TAB specialist's final payment.

3. If the second verification also fails, Owner, Engineer, or Architect may contact AABC Headquarters regarding the AABC National Performance Guaranty.

F. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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SECTION 16050

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Basic Electrical Requirements specifically applicable to Division 16 Sections
2. As-Built Documentation

B. Related Sections

1. Section 01140 – Work Restrictions
2. Section 01770 - Closeout Procedures
3. Section 02220 – Demolition
4. Section 16091 – Minor Electrical Demolition

1.2 REFERENCES

A. ASCE 7-10 – Minimum Design Loads for Buildings and Other Structures

B. International Building Code – IBC 2015

C. Massachusetts Electrical Code

D. Massachusetts State Building Code, current edition, 780 CMR

E. NFPA 70 - National Electrical Code

F. NFPA 79 – Electrical Standard for Industrial Machinery

G. ANSI/ISA-S5.4 – Instrument Loop Diagrams

1.3 SUBMITTALS

A. Submit shop drawings, product data, and reports.

B. Submit as-built documentation in accordance with Section 01770. I&C documentation shall conform to the latest versions of NFPA 79 and ANSI/ISA-S5.4.

C. Submit a written warranty.

D. Seismic restraint details including stamped certification from a professional engineer.

E. Provide a schedule of all Electrical system related Owner training, within one month of the Notice to Proceed. Prior to training, resubmit schedule if training is rescheduled and resubmit upon completion of all training. At a minimum, for each piece of equipment or system to be demonstrated, the schedule should include the following:

1. Equipment or system to be demonstrated
2. Related specification section
3. Anticipated date of training

4. Anticipated duration of training session

5. Name and company of instructor providing the training

6. Date completed

7. Actual duration of training session

F. Submit a Sequence of Construction for the demolition and installation of equipment with restrictions listed in this document and 01140. Sequence of Construction shall be updated during construction (if changes are required) and resubmitted for comment.

1.4 REGULATORY REQUIREMENTS

A. Conform to applicable Massachusetts Building Code.

B. Electrical - Conform to the state-adopted version of the National Electrical Code with Massachusetts amendments. All references to the National Electrical Code or NEC in the project manual or on the drawings shall be construed as references to the Massachusetts Electrical Code.

C. Conform to applicable Local Building Codes.

D. Obtain and pay for all applicable permits.

E. Schedule and pay for all inspections necessary for the electrical installation including but not necessarily limited to the general electrical inspection and fire department inspections.

1.5 PROJECT CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission from the Engineer before proceeding.

C. Location of electrical equipment, devices, and similar items, as indicated, are approximate only. Exact locations are to be determined by the Contractor during construction. If any location is different from those indicated (greater than 5 feet away from location shown on Drawings), the Engineer must give approval to the change.

D. Verify in field, existing conditions and final locations of equipment installed under other Sections that require electrical work.

E. Where it is necessary to core a hole through an existing concrete slab or wall, the Contractor shall conduct a survey with a pachometer or by similar means to identify the location of steel reinforcing bars. The new hole shall be located so as to avoid cutting reinforcing bars. Where reinforcing steel is close enough together that it is not possible to core the required hole without cutting reinforcing bars, contact the Engineer for further direction before cutting a hole. Where reinforcing bars are cut without the consent of the Engineer, the slab or wall will be repaired at the expense of the Contractor.

F. Equipment wiring

1. Equipment power and control wiring is based on specific manufacturers and models. Actual wiring required may be different.

2. Before pulling any power or control wire or installing conduit, obtain equipment electrical and control installation instructions and wiring diagrams. Any discrepancies from what is shown on the electrical drawings shall be brought to the attention of the Engineer. The Engineer will provide instructions for any changes that may be necessary.

3. Installation of conduit or wire prior to obtaining the above specified information shall be at the Contractor's risk. The Owner will not be responsible for any extra costs related to removal or replacement of conduit or wire resulting from the failure to coordinate equipment conduit and wire requirements. In the event that additional conductors or larger conductors than shown on the Drawings are required, the Owner will not be responsible for any labor costs related to the installation of these materials unless it can be demonstrated by the Contractor to the satisfaction of the Engineer that these conductors could not have been installed at the same time as the conductors shown on the Drawings.

4. Provide wiring shown on the Drawings unless specifically excluded.

G. Drawings and Specifications

1. Drawings and Specifications are typical of work done and of arrangement desired. Provide accessories and appurtenances necessary for complete installation (e.g., home runs, conduit and wire for instrumentation and control wiring) that are required to provide a complete electrical system.

H. As-Built Drawings: Maintain a master set of as-built drawings showing the changes and deviations from the Drawings or the approved shop drawings. Make markups as the changes are made.

I. Where underground electric facilities are installed, measure, record, and submit as built dimensions.

1.6 SEQUENCING AND SCHEDULING

A. Shutdown quantity and durations shall be minimized and limited to restrictions specified in 01140 Work Restrictions and as described below.

B. Provide temporary power source(s), motor controller(s), distribution equipment, wiring (power and signal) and conduit as required to keep all equipment operational at all times (except during switchovers), to meet requirements of 01140 Work Restrictions, and to meet requirements described below.

C. Coordinate shutdown schedule and durations with the Owner.

D. Install all conduit/wire to the extent feasible prior to shutdowns to minimize outage durations.

1.7 WARRANTY

A. Submit a written warranty, executed by the Contractor and manufacturer agreeing to the replacement and installation of all material, parts and adjustments required due to failure in materials or workmanship within one year from final acceptance of the Work.

B. This warranty shall be in addition to, and not a limitation of, other rights and remedies the Owner may have against any party under the Contract Documents. This warranty is in addition to all other warranties existing under either the Contract Documents or required by Law.

PART 2 PRODUCTS

2.1 GENERAL

A. Products shall be listed and labeled by a Nationally Recognized Testing Laboratory (NRTL) recognized by OSHA if a listing for that product is available. NRTL shall be Underwriter's Laboratory (UL), Electrical Testing Laboratory (ETL), Factory Mutual (FM) or equal.

B. Equipment Ampere Interrupting Capacity (AIC) and/or Short Circuit Current Rating (SCCR): Electrical equipment shall be labeled in accordance with NFPA 70 and have an Ampere Interrupting Capacity rating or Short Circuit Current Rating of equal to or greater than the following:

1. 208 or 240 volt equipment: 10,000 amps where fed from a transformer rated 45KVA or less, otherwise 35,000 amps

2.2 FINAL SYSTEM DOCUMENTATION

A. Prior to final acceptance of the system, provide operating and maintenance manuals (O&M's) covering instruction and maintenance on each type of equipment in accordance with Section 01770.

B. The requirements for final documentation shall be as specified in Section 01770.

PART 3 EXECUTION

3.1 INSTALLATION

A. Perform all work in accordance with OSHA (Occupational Safety and Health Administration) requirements.

B. Perform all work in accordance with NFPA 70E, Handbook for Electrical Safety in the Workplace.

C. Install all equipment in accordance with manufacturer's instructions and recommendations.

D. Test all electrical components in accordance with Section 16080 and as indicated in individual electrical equipment specification sections.

E. Perform all electrical equipment installation, checkout, and test in a safe manner. Provide the following special safety precautions, as appropriate:

1. Locking and tagging procedures
2. Barricades
3. De-energization and/or isolation of equipment prior to testing
4. Review of procedures with the Engineer and the Owner
5. Erection of warning signs
6. Stationing of guards and watchmen
7. Maintenance of voice communications
8. Personnel orientation

F. Do not install electrical equipment in its permanent location until structures are weather-tight or equipment is properly protected from the weather.

G. Before energizing any machine, visually inspect for serviceability. Verify that equipment and machines have been properly lubricated and aligned. Verify nameplate for electrical power requirements.

END OF SECTION

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SECTION 16060

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Power system grounding
2. Electrical equipment and raceway grounding and bonding
3. Grounding of piping, tanks, handrails and other conductive equipment
4. Communication system grounding
5. Grounding electrode system three-point test (to be performed by a third-party NETA-certified testing company)

B. Related Sections

1. Section 16080 – Electrical Testing

1.2 REFERENCES

A. NFPA 70 – National Electrical Code

B. UL 467 - Grounding and Bonding Equipment

C. UL 486A – Wire Connectors and Soldering Lugs for Use with Copper Conductors

D. UL 1059 – Terminal Blocks

E. IEEE/ANSI 142 – Latest Edition Recommended Practice for Grounding of Industrial and Commercial Power Systems.

F. IEEE 837 – Standards for Qualifying Permanent Connections Used in Substation Grounding

G. ASTM B3 - Solid Conductors

H. ASTM B8 – Assembly of Stranded Conductors

I. ASTM B33 – Tinned Conductors

J. NEMA GR1 – Ground Rods and Ground Rod Couplings

1.3 SYSTEM DESCRIPTION

A. Ground the electrical service system neutral and ground bus at the utility service entrance equipment to grounding electrodes. Grounding electrode system shall include a minimum of three driven ground rods, the underground water service pipe, sprinkler service pipe and the metal frame of the building (if effectively grounded). For new construction, the grounding electrode system shall include the rebar in accordance with NEC 250.52(A)(3). Run exposed grounding electrode conductors in conduit.

B. Ground each separately derived system neutral to the nearest effectively grounded building structural steel member or, if such is not available, to the nearest grounding electrode other than a water pipe.

C. Provide communications systems grounding conductor at point of service entrance and connect to nearest effectively grounded building structural steel member or, if such is not available, to the nearest grounding electrode other than a water pipe.

D. Bond together exposed non-current carrying metal parts of electrical equipment, handrails, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, metallic tanks and all metallic piping.

E. Install grounding in accordance with NEC Article 250.

1.4 SUBMITTALS

A. Submit shop drawings, product data, and reports.

B. Indicate layout of ground rods, location of system grounding electrode connections, and routing of grounding electrode conductor.

C. Submit ground resistance testing reports in accordance with Section 16080

PART 2 PRODUCTS

2.1 MATERIALS

A. Grounding Electrode Conductors

1. Type: Medium-hard drawn bare copper

2. Manufacturer

a. Okonite Co.

b. Rome Cable Corp.

c. American Insulated Wire Corp.

d. Southwire

e. or equal

B. Grounding Conductors - insulated copper, minimum size #12 AWG and in accordance with NEC Tables 250.66, 250.102(C)(1) and 250.122, or larger if so indicated on the Drawings

C. Ground Rods: Copper-clad steel, ¾inch diameter, minimum length 10 feet

D. Connectors - Mechanical

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lock washers shall be made of silicon bronze and supplied as part of the connector body and shall be two bolted pressure types.

3. The connectors shall meet or exceed UL467 and be clearly marked with the catalog number, conductor size and manufacturer.

    a. Manufacturer

        1) ABB Blackburn Installation Products

        2) Burndy

        3) Ilsco

        4) Or equal

E. Connectors - Compression

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. Irreversible compression connectors that meet or exceed the performance requirements of IEEE837, UL467 latest revisions. Compression connectors shall be listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and specific types, sizes and combinations of conductors and other items connected.

3. The irreversible compression connectors shall be manufactured of from pure wrought copper.

    a. The installation of the connectors shall be made with a hydraulic compression tool and die system clearly showing embossed die stamp on each crimp as recommended by the manufacturer of the connectors

    b. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size

    c. Each connector shall be factory filled with an oxide – inhibiting compound where applicable.

4. Manufacturer

    a. ABB Blackburn Installation Products

    b. Burndy

    c. Ilsco

    d. Or equal

F. Connectors - Welded

1. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used and specific types, sizes and combination of conductors and items connected.

2. Exothermic welded connections for copper to copper and copper to steel connections to ground rods, ground buses, ground wires, steel beams etc.

3. Conductors spliced with exothermic welded connections shall be considered as a continuous conductor, as stated in the noted accompanying NEC Article 250.50, 250.64 and IEEE Standard 80 latest edition.

a. Procedures outlined in the manufacturer's installation instructions shall be followed. Molds shall not be modified during installation in field applications

b. Weld metals shall be a mixture of copper oxide and aluminum. Only one weld metal mixture shall be required for each grounding connection.

c. Grounding connections shall be tested and certified in accordance with IEEE837, UL487A and UL 467.

d. Manufacturer

1) ABB Furseweld Installation Products

2) Burndy Thermoweld

3) Erico Cadweld

4) Or equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide a separate, insulated equipment grounding conductor with each feeder and branch circuit. Terminate each end on a grounding lug, bus, or bushing.

B. Run all exposed grounding electrode conductors and equipment grounding conductors in conduit.

C. Use a minimum of #8 AWG copper wire to ground all piping, tanks, handrails and other conductive equipment or structures including ductwork and floor gratings.

D. Use grounding bushings on all conduits stubbed up below equipment, panelboards, switchboards and motor control centers. Bond all conduits to ground bus. Use grounding bushings to ground electrical equipment and exposed non-current carrying metal parts.

E. Use the following types of ground connections for the grounding electrode system:

1. Cable to cable & cable to ground rod: Use exothermic weld type

2. Cable to building structural and reinforcing steel: Use exothermic weld type

3. Cable to piping: Use mechanical type

F. Supplementary Grounding Electrode: Use effectively grounded metal frame and rebar of the building and ground rods spaced a minimum of 10 feet apart in sufficient quantity to have a measured resistance to ground of not more than 5 ohms.

G. Use minimum #6 AWG copper conductor for communications service grounding conductor. Leave 10' slack conductor at terminal board.

H. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to service grounding electrode.

I. Drive ground rods one foot below finished grade.

J. Ground the water pipe as required by NEC Article 250. Provide a grounding jumper over the water meter as required. Provide a grounding jumper over all meters installed on incoming metallic piping for utility equipment.

3.2 FIELD QUALITY CONTROL

A. Inspect grounding and bonding system conductors and connections for tightness and proper installation and compliance with NEC Article 250.

3.3 TESTING

A. Perform ground tests using a low resistance, Null balance type, ground testing ohmmeter, with test lead resistance compensated for. Use the type of test instrument which compensates for potential and current rod resistances.

B. Test the grounding electrode system using a fall of potential three-point test and measure ground resistance. This test shall be performed by a third-party NETA–certified testing company. Submit tabulation of results to the Engineer. Include identification of electrodes, date of reading and ground resistance value in the test reports. If the resistance is not 5 ohms or less, contact the Engineer. The Engineer will initiate design changes, if necessary, to obtain acceptable values of ground resistance.

C. Ground resistance of conduits, equipment cases, and supporting frames, shall not vary from that of system as a whole and shall not exceed 0.5 ohms to ground. Measure resistance to ground of representative items, as directed by the Engineer. Submit all readings to the Engineer.

END OF SECTION

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SECTION 16070

ELECTRICAL HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Support channel
2. Fastening hardware
3. Anchor bolts
4. Polymer Housekeeping Pads

1.2 REFERENCES

A. ASTM A-780 – Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dipped Galvanized Coatings

1.3 SUBMITTALS

A. Submit shop drawings, product data, and reports.

1.4 QUALITY ASSURANCE

A. Support systems shall be adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 PRODUCTS

2.1 SUPPORT CHANNEL

A. Support channel assembly hardware shall be aluminum where aluminum conduit is used, and galvanized steel elsewhere.

B. In wet locations, support channel components in contact with the floor shall be stainless steel.

C. Manufacturer:

1. Unistrut
2. B-Line
3. ABB Super Strut Installation Products
4. Or equal

2.2 FASTENING HARDWARE

A. All fastening hardware shall be aluminum where aluminum conduit is used, fiberglass where fiberglass support channel is used, and galvanized steel elsewhere unless noted otherwise.

2.3 ANCHOR BOLTS

A. Anchor bolts shall be suitable for cracked or uncracked concrete and CMU construction.

B. Anchor bolts, nuts, washers, bolt sleeves, and assembly hardware shall be Type 316 stainless steel.

C. Use expansion anchors in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces.

D. Manufacturer:

1. Hilti, Kwik-Bolt TZ SS 316
2. Powers Fasteners, Power-Stud+ SD6
3. Simpson Strong-Tie, Strong-Bolt 2
4. Or Equal

2.4 PIPE CLAMPS AND STANDOFFS

A. Pipe clamps and standoffs shall be rigid one hole, galvanized malleable iron type or aluminum where aluminum conduit is used. They shall be of the same manufacturer and shall be designed to be used together.

B. Strut pipe clamps shall be 2-piece type, stainless steel, aluminum where aluminum conduit is used, and galvanized steel elsewhere.

2.5 SCREWS

A. Use Sheet Metal Screws in sheet metal studs.

B. Use Wood Screws in wood construction.

PART 3 EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, preset inserts or beam clamps. Do not use spring steel clips and clamps.

B. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

C. Do not use powder-actuated anchors.

D. Hanger rods shall be subjected to tension only. Lateral and axial movements shall be accommodated by proper linkage in the rod assembly.

E. Fabricate supports from support channel rigidly welded or bolted to present a neat appearance. Galvanized structural steel may be used where galvanized support channel is allowed. Use galvanized steel hexagon head bolts with spring lock washers under all nuts. Coat ends of galvanized steel channel that has been cut with zinc-rich paint in accordance with ASTM A-780.

F. Install freestanding electrical equipment on 4 inch concrete housekeeping pads.

G. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide channel supports to stand cabinet 1 inch off wall.

H. Bridge studs top and bottom with galvanized steel channels to support flush-mounted cabinets and panelboards in stud walls.

I. Use standoffs for all surface mounted conduit to maintain ¼ inch space between conduits and walls.

END OF SECTION

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SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Nameplates

2. Wire and cable markers

1.2 REFERENCES

A. NEMA WC5 - Thermoplastics - Insulated Wire and Cable for Transmission and Distribution of Electrical Energy

B. ANSI C57

1.3 SUBMITTALS

A. Provide schedule for nameplates.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Engraved two-layer plastic, white letters on a black background

B. Nameplate Wording:

1. Wording of the nameplates shall be in conformance with Drawings and acceptable to the Owner.

2. Wording of the nameplates for each piece of equipment shall be based on the common name and tag number (when applicable) of the equipment.

2.2 WIRE AND CABLE MARKERS

A. Wires up to AWG10: Split sleeve or tubing type waterproof markers (Thomas & Betts, Panduit, Burndy or equal).

B. Wires AWG8 and larger: Plastic impregnated cloth markers, resistant to abrasion, moisture, dirt and oil (Ideal, Panduit, Brady or equal).

PART 3 EXECUTION

3.1 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Secure nameplates to equipment fronts using ASA Type U drive screws, and water-resistant adhesive. Secure nameplate to face of panelboard doors one third of the way down from the top of the door. Embossed tape will not be permitted for any application.

3.2 WIRE IDENTIFICATION

A. Provide wire markers on each end of each conductor in panelboard gutters, pull boxes, outlet and junction boxes, switchgear, switchboards, motor control centers, control panels, at each load connection and at each terminal board connection. Identify wiring as following:

1. Power and lighting circuit wires: Wire markers shall identify (a) power source/panelboard name and circuit ID number (e.g. "LP-1,2,3"), and (b) load/equipment name (e.g. "VFD 1").

2. Control & signal wiring: The identification on wire markers shall match the ID tag number of the wire/terminal shown on the associated equipment shop drawings.

B. Circuits passing through junction boxes shall be individually grouped and bound with Ty-raps.

C. Include the following color coding of all conductors used for power or lighting circuits.

1. 120/240 volt, single phase 3 wire

a. Black - Phase A

b. Red - Phase B

c. White - Neutral

d. Green - Equipment ground

2. 120/208 volt, three phase 4 wire

a. Black - Phase A

b. Red - Phase B

c. Blue - Phase C

d. White - Neutral

e. Green - Equipment ground

3. 277/480 volt 3 phase 4 wire

a. Brown - Phase A

b. Orange - Phase B

c. Yellow - Phase C

d. Gray - Neutral

e. Green - Equipment ground

D. Color coding of multiconductor control cables shall be in accordance with NEMA Standard WC5.

E. Wire colors and sizes shall comply with requirements in the Wire Identification section of AWC's "Electrical Specification Standards" (located in the Appendix at the end of these specifications).

F. Wire labeling and numbering for all field wiring connected to PLC panels or other control panels shall comply with requirements in the Wire Identification section of AWC's "Electrical Specification Standards" (located in the Appendix at the end of these specifications).

3.3 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates of minimum letter height as scheduled below.

B. Panelboards, - ¼ inch to identify equipment designation, 1/8 inch to identify voltage rating and source.

C. Switches in Panelboards, - ¼ inch to identify circuit and load served, including location.

D. Individual Circuit Breakers, Enclosed Switches, Remote Operator Stations, Time Clocks, Control Devices, and Motor Starters – 1/8 inch to identify load served.

E. Transformers - ¼ inch to identify equipment designation, 1/8 inch to identify primary and secondary voltages, primary source, and secondary load and location. Power transformer nameplates shall be in accordance with ANSI C57.

F. Pumps, fans, and other electrical equipment - ¼ inch to identify circuit and equipment designation.

G. Equipment with More Than One Power Source, Including Motors with Heaters - ¼ inch to identify power sources. Mount nameplate on motor disconnect switch, equipment enclosure, or other prominent location.

END OF SECTION

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SECTION 16091

MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Electrical demolition

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment for patching and extending work: as specified in individual Sections.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field measurements and circuiting arrangements are as shown on Drawings.

B. Verify that abandoned wiring and equipment serve only abandoned facilities.

C. Demolition Drawings are based on field observation and existing record documents. Report discrepancies to the Engineer before disturbing existing installation.

D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

A. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

B. Provide temporary power source(s), wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

C. Existing Electrical System: Disable system only to make switchovers and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area. Verify permission to disable with the Owner immediately before the work. See 16050 and 01140 for additional requirements.

D. Existing Fire Alarm System: Disable system only to make switchovers and connections. Notify Owner and local fire service at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

A. Demolish and extend existing electrical work under provisions of this Section.

B. Remove, relocate, and extend existing installations to accommodate new construction.

C. Remove abandoned wiring to source of supply.

D. Remove exposed abandoned conduit, boxes, supports and fasteners, including above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

E. Voids created by the removal of conduit in floors or walls above or below ceilings shall be patched and sealed with materials matching the existing construction.

F. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.

G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

H. Repair adjacent construction and finishes damaged during demolition and extension work with materials matching the existing construction.

I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

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

3.4 CLEANING AND REPAIR

A. Clean and repair existing materials and equipment which remain or are to be reused.

B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangements.

3.5 INSTALLATION

A. Install relocated materials and equipment as indicated.

END OF SECTION

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SECTION 16120

CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Building wire and cable
2. Shielded signal cable
3. Metal clad (MC) cable
4. Hazardous location cable
5. Coaxial cable
6. Data highway cable
7. Device Net cable
8. RS-485 cable
9. Underground telephone cable
10. Wire connectors

B. Related Sections

1. Section 16075 - Electrical Identification

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

1.3 SUBMITTALS

A. Submit shop drawings, product data and reports.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.5 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions. Determine required separation between cable and other work.

C. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Description: Stranded conductor insulated wire, multi-conductor control cable and tray cable.

B. Conductor: copper

C. Insulation Voltage Rating: 600 volts

D. Insulation Temperature Rating: 90°C

E. Insulation: ANSI/NFPA 70; all power and control wiring shall be XHHW-2 unless otherwise indicated in this specification.

F. Manufacturer

1. Okonite Co.
2. Rome Cable Corp.
3. American Insulated Wire Corp.
4. Southwire
5. or equal

2.2 SHIELDED SIGNAL CABLE

A. Description: twisted pair shielded instrumentation wire, NEC type TC listed, wet location, approved for Class 1 circuits as permitted in NEC Article 725.

B. Conductor: tinned copper 18 AWG

C. Insulation Material: PVC with a nylon overcoat

D. Insulation Temperature Rating: 75°C wet, 90°C dry

E. Shield: 100% coverage, with drain wire

F. Jacket: 90°C PVC

G. Insulation voltage rating: 600 volts

H. Manufacturer

1. Belden No. 9341
2. Approved equal by Alpha
3. Approved equal by Clifford
4. or equal

2.3 SHIELDED SIGNAL CABLE

A. Description: Two twisted pairs, pairs individually foil shielded, with one drain wire per pair, Class 2.

B. Conductors: 18 AWG

C. Conductor Color:

1. Pair 1: Red/Black
2. Pair 2: White/Green

D. Insulation Voltage Rating: 300 volts

E. Jacket: Grey PVC

F. OD: Approx. 0.2 inches

G. Manufacturer: Smartwire

2.4 SHIELDED 3-CONDUCTOR CABLE

A. Description: Three-conductor shielded instrumentation cable, NEC type TC listed, wet location, approved for Class 1 circuits as permitted in NEC Article 725.

B. Conductor: Tinned copper 18 AWG

C. Insulation Material: PVC with nylon overcoat

D. Insulation Temperature Rating: 75°C wet, 90°C dry

E. Insulation Voltage Rating: 600 volts

F. Shield: 100% shield coverage, with drain wire

G. Jacket: 90°C PVC

H. Manufacturer

1. Belden No. 1121A
2. Approved equal by Alpha
3. Approved equal by Clifford
4. or equal

2.5 HAZARDOUS LOCATION CABLE

A. For use where cable is run exposed in a hazardous (Class I, Division 1 or Division 2) location.

B. Description: Type TC-ER-HL cable, UL listed, crush and impact resistance tray cable without external armoring, suitable for Class I, Div 1 and Zone 1 environments. Gas and vapor tight, impervious to water and air, flame retardant IEEE 1202. Three or four-wire cable with ground.

C. Conductor: tinned copper

D. Insulation Voltage Rating: 600/1000V TC-ER-HL

E. Jacket: flame retardant, oil, abrasion, chemical and sunlight resistant.

F. For connection to the equipment/enclosure, provide explosion-proof cable gland rated for the classification of the area and stainless steel kellems grip.

G. Manufacturer

1. Nexans AmerCable CIR
2. Southwire Halo-Flex
3. Equal by Belden
4. or equal

2.6 COAXIAL CABLE

A. Description: RG59/U Coaxial cable

B. Provide coaxial cable in accordance with industry standards and manufacturer's requirements and recommendations.

2.7 DATA HIGHWAY CABLE

A. Manufacturer: Allen Bradley

B. Type: Data Highway + Cable

2.8 SHIELDED DEVICENET SIGNAL CABLE

A. Description: Twisted pair shielded instrumentation wire, NEC type TC listed, approved for Class 1 circuits as permitted in NEC Article 725

B. Power Conductor: tinned copper, 16 AWG

C. Power Conductor Insulation Material: PVC with a nylon overcoat

D. Power conductors colored Red/Black

E. Data Conductor: tinned copper 18 AWG

F. Data Conductor Insulation Material: F-R Polypropylene

G. Data conductors colored Blue/White

H. Insulation Temperature Rating: 75°C

I. Shield: 100% coverage, with 18 AWG stranded drain wire

J. Insulation voltage rating: 600 volts

K. Manufacturer

1. Belden No. 7896A
2. Approved equal by Alpha
3. Approved equal by Clifford

2.9 ETHERNET CABLE

A. Description: NEC CMR cable, Category 6 unbonded-pair cable

B. Construction: 23 AWG solid bare copper, 4 twisted pairs, overall shield, drain wire, RJ-45 compatible, non-plenum, polyolefin (PO) or PO+FEP insulation, PVC jacket.

C. Manufacturer

1. Belden 2412F

2. Approved equal by Alpha

3. Approved equal by Quabbin

2.10 RS-485 CABLE

A. Description: Twisted 4-pair, NEC CL2, shielded, low capacitance cable.

B. Temperature Rating: 80ºC

C. Voltage Rating: 30 volts

D. Conductor: 28 AWG stranded, tinned copper

E. Shielding: 100% coverage with 28 AWG tinned copper drain wire

F. Insulation: Datalene

G. Jacket: Chrome PVC

H. Manufacturer

1. Belden 8134FO

2. Approved equal

2.11 UNDERGROUND TELEPHONE CABLE

A. Description: 300 volt power-limited tray cable

B. Insulation: F-R PVC

C. Jacket: F-R PVC

D. Shield: 100%

E. Number of Pairs: 4

F. Conductors: 22 AWG stranded tinned copper, twisted pairs

G. Manufacturer

1. Belden 9514

2. Approved equal

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that interior of building has been protected from weather.

B. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Minimum size for power wiring shall be AWG #12.

B. Minimum size for control wiring shall be AWG #14.

C. All wiring shall be run in conduit, unless otherwise noted.

D. Install products in accordance with manufacturers instructions.

E. Use stranded conductors for all wire sizes.

F. In raceways, mechanically complete the installation in all details. Pull all conductors into raceway at same time.

G. Use suitable wire pulling lubricant for building wire 4 AWG and larger.

H. Protect exposed cable from damage.

I. Support cables above accessible ceiling, using spring metal clips or metal cable ties to support cables from structure. Do not rest cable on ceiling panels.

J. Use suitable cable fittings and connectors.

K. Neatly train and lace wiring inside boxes, equipment, and panelboards.

L. Clean conductor surfaces before installing lugs and connectors.

M. Instrumentation, control and signal wiring shall be continuous with no splices from source to destination, unless otherwise shown on drawings.

N. Splices

1. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

2. Properly connect and insulate shields at all splice points.

3. Underground Splices or Splices called out to be Submersible

   a. Provide Polaris Submersible Splice Connectors or equal one-piece system by Burndy, Blackburn or equal.

   b. Underground splices shall be made in a handhole or manhole provided by the contractor and sized per the NEC.

4. Above grade splices

   a. 8 AWG and Larger: Use split bolt connectors for copper conductor splices and taps. Tape uninsulated conductors and connector with electrical tape to 150 percent of insulation rating of conductor.

   b. 10 AWG and smaller: Use insulated spring wire connectors with plastic caps for copper conductor splices and taps.

5. Above ground splices wire reducer

   a. When wire size has been increased to account for derating and/or voltage drop, provide an In-Line Standard Barrel Reducer Splice Kit to reduce the wire down to the size necessary to terminate at the circuit breaker, disconnect, equipment, etc.

   b. The reduced wire shall be sized by the contractor per NEC Table 310.15(B)(16) using the 60^0C Column. The wire shall be sized according to the upstream over current protective device size.

c. The splice kit shall contain clear heat shrink tube to protect the butt splice.

d. Tape splice with electrical tape to 150 percent of insulation rating of conductor.

e. The Reducer splice kit shall be:

1) Butt splice compression type with inspection window.

2) Tin plated Copper

3) Provide Burndy Hyreducer or equal by Blackburn, Polaris or equal.

O. Ground signal cable shields on receiving end only.

P. Provide Kellems grips for all cord connected devices.

Q. Provide separation of power wiring from control and signal wire in accordance with NEC Article 725.

R. Install coaxial cables in accordance with industry standards and manufacturer's requirements and recommendations.

S. Install Device Net cables in accordance with manufacturer's instructions and NEC Article 725 requirements for Class 1 wiring.

T. Install Ethernet cables in accordance with manufacturer's instructions and industry standards for category 6 wiring.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Section 16075

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.5 FIELD QUALITY CONTROL

A. Inspect wire and cable for physical damage and proper connection.

B. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

C. Verify continuity of each branch circuit conductor.

END OF SECTION

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SECTION 16136

BOXES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Wall and ceiling outlet/device boxes
2. Pull and junction boxes
3. Floor Boxes
4. Covers
5. Conduit Hubs

1.2 REFERENCES

A. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes and Conduit Bodies for Conduit and Cable Assemblies

B. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports

C. ANSI/NFPA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports

D. NEMA 250 - Enclosures for Electrical Equipment (1000 volts maximum)

E. UL514 A – Metallic Outlet Boxes

F. UL514 C – Nonmetallic Outlet Boxes, Flush-Device Covers and Covers

1.3 SUBMITTALS

A. Shop drawings, product data, and reports

1.4 PROJECT CONDITIONS

A. Verify that the field measurements are as shown on the Drawings.

B. Verify locations of outlets in offices and work areas prior to rough-in.

C. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose. Include installation within 5 feet of location shown.

1.5 DESIGN REQUIREMENTS

A. Unless otherwise specified or indicated on Drawings, NEMA rating for boxes shall correspond as follows to location classifications indicated on Drawings. Indoor locations for which a classification is not indicated are to be considered dry locations unless otherwise designated by Code. Outdoor locations are to be considered wet locations unless otherwise indicated.

1. Dry locations - NEMA 1 Metallic Boxes

2. Damp locations and Wet locations - NEMA 4 Metallic Boxes

3. Corrosive locations - NEMA 4X Metallic and Non-Metallic Boxes (metallic where metallic conduit is used, non-metallic where non-metallic conduit is used)

4. Wet & Corrosive locations - NEMA 4X Metallic and Non-Metallic Boxes (metallic where metallic conduit is used, non-metallic where non-metallic conduit is used)

5. Class 1 Division 1 or 2 Group D - NEMA 7, gasketed , cast aluminum Boxes

6. All boxes associated with the fire alarm system shall be field-painted red with a red cover.

PART 2 PRODUCTS

2.1 WALL AND CEILING OUTLET/DEVICE BOXES

A. Sheet Metal (stamped steel) Outlet/Device Boxes

1. NEMA OS 1, galvanized steel.

2. Provide green grounding screw.

3. Stamped steel boxes shall be used only above accessible ceilings and within Gypsum wall board walls.

4. Acceptable Manufacturers

a. ABB Steel City Installation Products

b. Appleton

c. Raco

d. or equal

B. Cast Metal Outlet/Device Boxes

1. NEMA FB 1, Type FD, cast iron or copper-free aluminum with internal green grounding screw terminal.

2. Shall be suitable for use in wet locations when used with gasketed covers.

3. Cover shall be by box manufacturer, and shall have stainless steel cover screws and a neoprene gasket.

4. Boxes shall have external mounting feet cast into the box assembly, screw-in feet will not be acceptable.

5. Material and coating shall match that of the conduit system being used.

6. Provide threaded sealing conduit hubs on all conduit entries.

7. Acceptable Manufacturers

a. ABB Installation Products

b. Crouse-Hinds

c. Appleton

d. Hubbell

e. or equal

C. Non-metallic Outlet/Device Boxes

1. NEMA OS 2.

2. Cover shall be by box manufacturer, and shall have stainless steel cover screws and gasket.

3. Screws shall be stainless steel.

4. Acceptable Manufacturers

a. ABB Steel City Installation Products

b. Raco

c. or equal

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Pull and Junction Boxes

1. NEMA OS 1, Galvanized or Painted Steel.

2. Provide green grounding screw.

3. Boxes shall not contain knockouts, unless used with EMT or IMC conduit.

4. Acceptable Manufacturers

a. ABB Steel City Installation Products

b. Raco

c. Appleton

d. or equal

B. NEMA 4X Stainless Steel Pull and Junction Boxes

1. NEMA OS 1, Type 4X Stainless Steel (16 gauge minimum). Screws shall be stainless steel.

2. Provide green grounding screw.

3. Acceptable Manufacturers

a. Hoffman, Inc.

b. McKinstry

c. Wiegmamn

d. or equal

C. Cast Metal Pull and Junction boxes

1. NEMA FB 1, type 4 cast iron or copper-free aluminum

2. Shall be suitable for use in wet locations when used with gasketed covers.

3. Cover shall be by box manufacturer, and shall have stainless steel cover screws and a neoprene gasket.

4. Material and coating shall match that of the conduit system being used.

5. Boxes shall have external mounting feet cast into the box assembly, screw-in feet will not be acceptable.

6. Provide threaded sealing conduit hubs on all conduit entries.

7. Provide green grounding screw.

8. Acceptable Manufacturers

   a. Crouse-Hinds

   b. Appleton

   c. Hubbell, Inc.

   d. or equal

D. Non-Metallic Pull and Junction Boxes

1. NEMA OS 2, NEMA 4X. Non-metallic boxes exceeding 18 inches in any direction shall be FRP type.

2. If located outdoors, the material shall be ultraviolet stabilized for outdoor use.

3. If located in a chemical area, the material shall be suitable for the chemicals in that area.

4. Screws shall be stainless steel.

5. Acceptable Manufacturers

   a. Raco

   b. ABB Carlon Installation Products

   c. Stahlin

   d. or equal

E. Boxes exceeding 48 inches in any direction shall be provided with angle iron stiffeners.

2.3 COVERS

A. Provide covers for all boxes. Cover material and coating shall match the box, unless otherwise specified. Covers shall be screw fastened or hinged and comply with NEMA Standards OS 1, OS 2 or FB 1.

2.4 CONDUIT HUBS

A. Conduit hubs shall be threaded and sealing type with neoprene gasket.

B. Conduit hub material and coating shall match that of the conduit.

C. Acceptable Manufacturers

1. ABB Thomas & Betts - type "BULLET"
2. Crouse Hinds - type "HUB"
3. Equal by Appleton
4. or equal

PART 3 EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as shown on Drawings. Provided additional boxes as required to comply with NFPA 70 requirements, for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

B. Provide separate boxes for 480 and 120/208/240 volts systems. Install motor feed and control wiring in the same box only when shown as combined in a single raceway on the Drawings or as approved by the Engineer.

C. Install electrical boxes to maintain headroom and to present neat mechanical appearance.

D. Boxes shall not be mounted to the floor in damp, wet or corrosive locations.

E. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

F. Use flush mounting outlet boxes in finished areas.

G. Secure flush mounting box to interior wall without damaging wall insulation or reducing its effectiveness. Accurately position to allow for surface finish thickness.

H. Do not fasten boxes to ceiling support wires.

I. Fasten boxes to walls, ceilings or strut supports; do not support boxes from equipment, panels, etc.

J. Support boxes independently of conduit, except cast box that is connected to two rigid metal conduits both supported within 12 inches of box.

K. Use gang box where more than one device is mounted together. Do not use sectional box.

L. Provide permanent barriers in common boxes to limit voltage between adjacent switches to 300 volts or less.

M. Common boxes used for gang installation with switches, receptacles, and low voltage devices shall include barriers between the devices and the switches or receptacles.

N. Through-the-wall outlet boxes shall not be permitted. Outlet boxes shall not be installed back-to-back but shall be staggered on opposite sides of partitions a minimum of 12" on center.

O. The Contractor shall furnish and install outlet boxes for all wiring devices as shown on the drawings.

P. Bar hanger type outlet boxes shall be used in hollow frame partitions, other than masonry or construction block partitions, with bar hanger supported from (2) partition

studs for wood stud partitions. For metal stud partitions, bar hanger shall be secured with self-threading metal screws or drill through hangers with caddy clips.

Q. Sheet Metal Outlet/Device Boxes

1. Use only above accessible ceilings and within Gypsum wall board walls.

R. Cast Metal Outlet/Device Boxes

1. Use in locations exposed to the weather, wet locations, damp locations, surface mounted and pendant mounted locations and all locations where non-PVC coated rigid conduit is used. Use sealing conduit hubs on all conduit entries.

S. Pull and Junction Boxes

1. Use sealing conduit hubs on all conduit entries.

2. Use stainless steel pull and junction boxes where PVC coated conduit is required and in locations rated as Wet and Corrosive, except where stainless steel is inadequate for corrosiveness of area. Use Non-Metallic in that case.

3. Use Cast Metal pull and junction boxes in all locations where non-PVC coated rigid conduit is used and in locations rated as Wet Location.

3.2 ADJUSTING

A. Install knockout closure in unused box opening.

END OF SECTION

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SECTION 16138

DUCT BANKS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Metal conduit
2. Nonmetallic conduit
3. Handholes
4. Installation of duct banks
5. Installation of handholes

B. Related Sections

1. Section 02315 - Excavation, Backfilling and Compaction
2. Section 03100 – Concrete Forms and Accessories
3. Section 03200 – Concrete Reinforcement
4. Section 03300 - Cast-In-Place Concrete

1.2 REFERENCES

A. AASHTO - Standard Specification for Highway Bridges

B. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated

C. ANSI/NEMA FB1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies

D. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing

E. ANSI/SCTE 77-2007 - Specification for Underground Enclosure Integrity

1.3 SUBMITTALS

A. Manufacturer’s shop drawings

B. Project data

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 5 years documented experience.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

1.5 DELIVERY, STORAGE AND HANDLING

A. Accept conduit on site. Inspect for damage.

B. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.6 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of duct bank prior to excavation for rough-in.

C. Duct bank routing is shown on Drawings in approximate locations unless dimensions are indicated. Route as required to complete duct system.

PART 2 PRODUCTS

2.1 NONMETALLIC CONDUIT

A. Description: NEMA TC-2 Schedule 40 PVC.

B. Fittings: NEMA TC-3.

2.2 METAL CONDUIT

A. Rigid steel conduit: ANSI C80.1

B. Fittings and conduit bodies: ANSI/NEMA FB1; all steel fittings

2.3 PRECAST MANHOLES

A. Concrete Strength: Portland Cement Type I or II, air-entrained, 4500 psi compressive strength at 28 days; density 150 pcf

B. Loading: AASHTO, H-20 in accordance with ASTM C857.

C. Drainage

1. Slope floors toward drain points, leaving no pockets or other nondraining areas.

2. Provide drainage outlet or sump at low point of floor constructed with a heavy, cast iron, clotted or perforated hinged cover, and 4-inch minimum outlet and outlet pipe.

D. Raceway Entrances

1. Provide on all four sides.

2. For raceways to be installed under this Contract, provide knockout panels or precast individual raceway openings.

3. At entrances where raceways are to be installed by others, provide minimum 12-inch high by 24-inch wide knockout panels for future raceway installation.

E. Embedded Pulling Iron

1. Material: 3/4-inch diameter stock, fastened to overall steel reinforcement before concrete is placed.

2. Location

a. Wall: Opposite each raceway entrance and knockout panel for future raceway entrance.

b. Floor: Centered below manhole or handhole cover.

F. Cable Racks

1. Arms and Insulators: Adjustable, of sufficient number to accommodate cables for each raceway entering or leaving manhole, including spares.

2. Wall Attachment

a. Adjustable inserts in concrete walls. Bolts or embedded studs not permitted.

b. Insert Spacing: Maximum 3-foot on center entire inside perimeter of manhole.

c. Arrange so that spare raceway ends are clear for future cable installation.

G. Hardware: Steel, hot-dip galvanized.

H. Furnish knockout for ground rod in each handhole and manhole, except those for fiber optic cable.

I. Manufacturers

1. Utility Vault Co.

2. Penn-Cast Products, Inc.

3. Concrete Conduit Co.

4. Associated Concrete Products, Inc.

J. Manholes for 13.8 kV utility service shall meet Utility Company requirements.

2.4 PRECAST CONCRETE HANDHOLES

A. Manufacturers

1. Chase Precast Products

2. Nashua Precast

3. Arrow Concrete Products or equal

B. Description

1. Concrete Strength: Portland Cement Type I or II, air-entrained, 4500 psi compressive strength at 28 days; density 150 pcf

2. Construction – bottomless, in modular sections with tongue and groove joints

3. Inside dimensions – as required by NEC Article 314.28

4. Knockouts for duct entry

C. Handhole Frames and Covers:

1. Material: Machined cast iron.

2. Cover Type: Indented, solid top design, with two drop handles each.

3. Cover Loading: AASHTO H-20.

4. Cover Designation: Cast, on upper side, in integral letters, minimum 2 inches in height, appropriate titles:
    a. Above 600 Volts: ELECTRIC HV.
    b. 600 Volts and Below: ELECTRIC LV.
    c. COMMUNICATIONS
    d. TELEPHONE

2.5 POLYMER CONCRETE HANDHOLES

A. Description
1. Material shall be a polyester resin in combination with selectively graded aggregates.
2. Material shall be resistant to ultraviolet light and unaffected by moisture and freezing.
3. Loading – Designed to meet ANSI/SCTE 77-2007 requirements for Tier 22 (33,750 lbs) applications.
4. Dimensions – as required, or as indicated on the Drawings.
5. Lid shall be provided by same manufacturer.
6. Any and all hardware required shall be stainless steel.

B. Manufacturers
1. Quazite - Composolite
2. Newbasis
3. or equal

2.6 ACCESSORIES

A. Duct Bank Spacers
1. Type: Nonmetallic, interlocking, for multiple conduit sizes.
2. Suitable for all types of conduit.
3. Manufacturers
    a. Underground Device, Inc.
    b. Carlon.

B. Identification Devices
1. Raceway Tags
    a. Material: Permanent, nylon or polyethylene.
    b. Shape: Round.
    c. Raceway Designation: Pressure stamped, embossed, or engraved.
    d. Tapes relying on adhesives or taped-on markers not permitted.

PART 3 EXECUTION

3.1 DUCT BANK INSTALLATION

A. Use Schedule 40 PVC/rigid galvanized steel conduit for all underground duct banks.

B. Install duct in accordance with manufacturer's instructions.

C. Install duct to locate top of duct bank at depths as indicated on drawings (or at 36 inches below grade depths not indicated on drawings).

D. Install duct with minimum slope of 1.5 inches per 100 feet. Slope duct away from building entrances.

E. Cut duct square using saw or pipe cutter; de-burr cut ends.

F. Insert duct to shoulder of fittings; fasten securely.

G. Join nonmetallic duct using adhesive as recommended by manufacturer.

H. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

I. Install no more than equivalent of three 90 degree bends between pull points.

J. Provide suitable fittings to accommodate expansion and deflection where required.

K. Terminate duct at manhole/handhole entries using end bell.

L. Stagger duct joints vertically in concrete encasement 6 inches minimum.

M. Use suitable separators and chairs installed not greater than 4 feet on centers.

N. Separate conduits by at least 7.5 inches center-to-center in duct banks.

O. Band ducts together before placing concrete.

P. Securely anchor duct to prevent movement during concrete placement.

Q. For non-concrete encased conduits, backfill the trench with sand borrow for the full width of the trench (at least 3 inches around sides and bottom of conduit) and extend the sand borrow 12 inches over the conduit. For non-concrete encased ductbanks with stacked conduits, run a vibratory plate over top of sand to settle the sand between/under conduits.

R. For concrete encased ductbanks, provide the following:

1. Poured in place concrete in accordance with the provisions of Sections 03100, 03200 and 03300

2. Minimum 3 inch concrete cover at bottom, top, and sides of duct bank.

3. Two No. 4 steel reinforcing bars in top of bank under paved areas.

4. Connect to existing concrete encasement using dowels.

S. Excavation, backfill and compaction of trenches shall be performed under provisions of Section 02315

T. Provide suitable pull string in each empty duct except sleeves and nipples.

U. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

V. Handhole and manhole sizes shall be as required by code.

W. Provide handholes and manholes where shown on the Drawings and provide additional handholes and manholes where required to meet code, meet Utility requirements, and as required to pull wiring without damaging insulation. Coordinate locations of additional handholes and manholes with the Engineer.

3.2 PREPARATION FOR INSTALLATION OF MANHOLES AND HANDHOLES

A. Contractor shall provide excavation, installation of base material, and compaction of base material in accordance with the provisions of Section 02315

3.3 INSTALLATION – PRECAST CONCRETE HANDHOLES

A. Install and seal precast sections in accordance with manufacturer's instructions.

B. Install handholes plumb.

C. Set the top of each handhole to finished grade.

3.4 INSTALLATION – POLYMER CONCRETE HANDHOLES

A. Install and seal sections in accordance with manufacturer's instructions.

B. Install handholes plumb.

C. Set the top of each handhole to finished grade.

3.5 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of exact routing of duct bank.

B. Accurately record actual locations of each manhole and each handhole.

END OF SECTION

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SECTION 16210

ELECTRIC SERVICE ENTRANCE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Arrangement with Utility Company for permanent electric services.

2. Payment by the Contractor for all Utility Company charges for the permanent electric services.

3. Underground service entrance.

1.2 SYSTEM DESCRIPTION

A. System Voltage:

1. 120/240 volts, single phase, 3-wire

1.3 QUALITY ASSURANCE

A. Utility Company: Eversourc}

B. Utility Engineer: Brian Mello, Telephone: 508-441-5832

C. Install service entrance in accordance with Utility Company's rules and regulations. Obtain Utility Company approvals prior to ordering any materials or starting any construction. Inform Engineer if Utility Company requires significant changes.

PART 2 PRODUCTS

2.1 SERVICE EQUIPMENT

A. Main Service Disconnect

1. Garage Service - 100 amp switch with 100 amp Breaker

2. Gatehouse Service - 100 amp switch with 100 amp Breaker.

B. Utility Meter

1. Meter socket, furnish in accordance with Utility Company requirements.

2. Meter, furnished by the Utility Company.

C. Underground Service

1. Riser pole, furnished by Utility Company.

2. Overhead service cable, cable terminations and installation, provided by Utility Company.

3. Underground secondary service cable, cable terminations and cable pulling, provide in accordance with Utility Company requirements.

4. Service conduit, 4 inch Schedule 40 PVC for service cables and one 4 inch Schedule 40 PVC spare conduit with pull string, furnish in accordance with

Utility Company requirements. Provide pull strings where required. Provide concrete encasement for conduits run beneath pavement.

5. Rigid steel sweep on riser pole and below combination meter main, provide in accordance with Utility Company requirements.

6. Provide conduit expansion fitting(s) below combination meter main.

D. Surge Protection Device (SPD)

1. Provide surge protection in accordance with Section 16490.

PART 3 EXECUTION

3.1 INSTALLATION

A. Make arrangements with Utility Company to obtain permanent electric service and to demolish the existing electric service.

B. Coordinate installation of trench for electric service in accordance with Utility Company requirements. Coordinate backfilling of trench, in accordance with Utility Company requirements, after cables have been installed.

C. Install electric service conduits (with pull strings where required) and cables, in accordance with Utility Company requirements.

D. Install rigid steel sweep and riser on Utility riser pole in accordance with Utility requirements.

E. Install rigid steel sweep and conduit expansion fitting(s) below combination meter main in accordance with Utility requirements.

F. Install meter socket in accordance with Utility Company requirements.

END OF SECTION

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SECTION 16410

SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Circuit Breakers

2. Switch Assemblies

B. Related Sections

1. Section 16070– Electrical Hangers and Supports

1.2 REFERENCES

A. NEMA AB 1 - Molded Case Circuit Breakers.

B. NEMA KS 1 – Enclosed Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

1.3 SUBMITTALS

A. Shop drawings, product data, and reports.

B. Circuit breaker trip current and let-through current curves, outline dimensions, and terminal lug sizes.

1.4 REGULATORY REQUIREMENTS

A. Use circuit breakers and switch assemblies listed by Underwriter's Laboratories, Inc., and suitable for specific application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton

B. Square D

C. Siemens

D. Or equal

2.2 MOLDED CASE CIRCUIT BREAKER

A. CIRCUIT BREAKER: NEMA AB-1. FS W-C-375.

B. Service Conditions:

1. Temperature: 40 C.

C. Interrupting Rating: For circuit breakers that are part of a panelboard or other equipment, the interrupting rating shall be equal to or greater than that of the equipment. For stand-alone circuit breakers, the interrupting rating shall be a minimum of 35,000 AIC.

D. Enclosure: NEMA 12 dust tight industrial indoor dry locations, NEMA 3R raintight (lockable) for outdoor locations, and NEMA 4X stainless steel for wet and damp locations. For Class I, Division 1 or 2 locations, provide NEMA 7 enclosures. For corrosive areas, provide NEMA 4X stainless steel or nonmetallic enclosures.

E. Configuration: Inverse time automatic tripping. Instantaneous automatic tripping, for motor circuit protection.

F. Field-Adjustable Trip Circuit Breaker: NEMA AB 1; provide circuit breakers with frame sizes 100 amperes and larger with mechanism for adjusting long time, short time continuous current, short time, long time pickup current, and instantaneous setting for automatic operation.

G. Solid-State Circuit Breaker: Provide circuit breaker as scheduled with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip with integral ground fault sensing; zero sequence type ground fault sensor; instantaneous trip; and adjustable short time trip.

H. Ratings: NEMA AB 1; as scheduled.

I. Provide a lockable hasp with each circuit breaker.

2.3 SWITCH ASSEMBLIES

A. Interrupting Rating: The interrupting rating shall be a minimum of 35,000 AIC.

B. Nonfusible Switch Assemblies: NEMA KS 1; FS W-S-865; heavy duty, quick-make, quick-break, load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF and ON positions.

C. Fusible Switch Assemblies: NEMA KS 1; FS W-S-865; heavy duty, quick-make, quick-break load interrupter enclosed knife switch with externally operable handle. Provide interlock to prevent opening front cover with switch in ON position. Handle lockable in OFF and ON positions. Fuse Clips: FS W-F-870. Designed to accommodate Class R fuses unless otherwise indicated.

D. The switch ampacity shall meet or exceed the circuit ampacity shown on the drawings.

E. Accessories:

1. Unless shown otherwise, provide all fusible disconnect switches with fuses rated for the full ampacity of the disconnect switch frame.

2. Provide all disconnect switches downstream from VFDs or Soft-Starters with auxiliary contacts.

F. Enclosure: NEMA 12 for indoor dry locations, NEMA 3R raintight (lockable) for outdoor locations, and NEMA 4X stainless steel for wet and damp locations. For Class I, Division 1 or 2 locations, provide NEMA 7 enclosures. For corrosive areas, provide NEMA 4X stainless steel or nonmetallic enclosures.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

3.2 INSTALLATION

A. Install circuit breakers and switch assemblies where shown on Drawings, in accordance with manufacturer's instructions.

B. Provide all necessary hardware and supports and make all wiring connections.

C. Support equipment of this Section in accordance with Section 16070.

D. Provide fuses in all fusible switch assemblies, whether fuses are shown on the drawings or not. For HVAC equipment, coordinate fuse size required with HVAC contractor.

3.3 FIELD QUALITY CONTROL

A. Inspect visually and perform several mechanical ON-OFF operations on each circuit breaker and switch assembly.

B. Verify circuit continuity on each pole in closed position.

END OF SECTION

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SECTION 16440

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Panelboards

2. Molded case circuit breakers

B. Related Sections

1. Section 16075 – Electrical Identification

2. Section 16410 – Switches and Circuit Breakers

1.2 REFERENCES

A. NEMA PB 1 - Panelboards.

B. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

1.3 SUBMITTALS

A. Provide outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

PART 2 PRODUCTS

2.1 MANUFACTURERS - PANELBOARDS

A. Panelboards, 208/120 volt with mains from 100 amperes to 400 amperes, max 42-84 branch circuits and no branch breakers over 100 amperes, shall be:

1. Eaton, PRL-1

2. Square D, NQ

3. Siemens, P1

4. ABB/General Electric, AQ

5. or equal

B. Panelboards, 480/277 volt or 208/120 volt with mains from 100 amperes to 400 amperes, max 60 branch circuits with MCB, or max 74 branch circuits with MLO, and no branch breakers over 225 amperes, shall be:

1. Eaton, PRL-3

2. Square D, NF or I-Line

3. Siemens, P3

4. ABB/General Electric, AD

5. or equal

2.2 PANELBOARDS

A. Panelboards: NEMA PB-1; circuit breaker type

B. Enclosure: NEMA Type 1 in dry locations, NEMA Type 4 in wet or damp locations, unless otherwise indicated on Drawings

C. Provide cabinet front with hinged cover, and hinged door with flush lock. Finish in manufacturer's standard gray enamel.

D. Provide panelboards with copper bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards. Provide separate insulated neutral bus, where required.

E. Provide factory installed lockable hasps for all breakers.

F. The maximum panel dimensions listed are based on Eaton equipment. If the Contractor elects to use one of the alternative manufactures listed, the Contractor shall be responsible to verify the equipment will fit in the space shown on the Contract Drawings and shall be responsible for all costs associated with using the alternative manufacturer such as, but not limited to building modification, equipment modification, feeder and branch circuit wiring, etc.

1. Panelboards, 208/120 volt with mains from 100 amperes to 400 amperes, max 42 branch circuits and no branch breakers over 100 amperes, shall be a maximum of 72”H x 20”W x 5.75”D.

G. Ratings

1. All panels and individually mounted circuit breakers shall have short circuit ratings as follows:

a. 240 Volt Class Panels/Breakers

1) 10 kAIC where shown fed via transformers 50 kVA or less

2) 22 kAIC where shown fed via transformers 150 kVA or less

3) 65 kAIC where shown fed via transformers 167 kVA or higher

2. All panelboards shall be UL listed and labeled. Panels shall have ratings not less than the short circuit ratings available from the power sources.

3. Panelboards shall be labeled with a UL short circuit rating. Panelboards shall be fully rated.

H. Trims

1. Trims for all panelboards shall be supplied with a door-in-hinged-door. Interior door shall cover all circuit breaker handles and not uncover any live parts. Outer hinged door shall have a piano/continuous hinge and shall open to provide access to all wire gutter space on both sides of circuit breakers. Doors shall have a semi-flush cylinder lock and catch assembly. Doors over 48 inches in height shall have auxiliary fasteners. Refer to drawings for surface or recessed mounted. Switching device handles shall be accessible.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Provide circuit breakers in accordance with Section 16410.

B. Provide bolt-in circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

C. Provide factory installed lockable hasps for all breakers.

D. Field-Adjustable Trip Circuit Breaker: NEMA AB 1; provide circuit breakers with frame sizes 100 amperes and larger with mechanism for adjusting long time, short time continuous current, short time, long time pickup current, and instantaneous setting for automatic operation.

E. Trip-free mechanism independent of manual handle control.

F. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

G. Provide GFPE (ground-fault protection of equipment) type circuit breakers of circuits feeding heat trace systems.

H. Provide ground fault interrupter circuit breakers for circuits indicated on Drawings.

I. Do not use single pole breakers with handle tie for multipole use.

PART 3 EXECUTION

3.1 INSTALLATION

A. Panel board shall be wall mounted as shown on the Drawings.

B. Install wall mounted panelboards plumb in conformance with NEMA PB 1.1, at a height of 6 feet to the top of the panelboard.

C. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

D. Make all electrical connections including grounding.

E. Provide engraved nameplates in accordance with Section 16075

F. Provide a blue marking “Premises Security Circuit” on the security control panel circuit breaker. Provide a permanent sign for the security control panel stating the location of this circuit breaker.

3.2 FIELD QUALITY CONTROL

A. With all equipment connected and functioning normally, measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20%, rearrange circuits in the panelboard to balance the phase loads within 20%. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection - Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

END OF SECTION

SECTION 16520

EXTERIOR LUMINAIRES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Exterior luminaires and accessories

2. Poles

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ANSI/IES RP-8 - Recommended Practice for Roadway Lighting.

1.3 SUBMITTALS

A. Shop Drawings: Indicate dimensions and components for each luminaire and pole.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 3 years experience.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc. and testing firm acceptable to authority having jurisdiction.

1.6 COORDINATION

A. Furnish bolt templates and pole mounting accessories to installer of pole foundations.

PART 2 MATERIALS

2.1 GENERAL

A. Provide materials, equipment, appurtenances and workmanship for the work of this Section conforming to the highest commercial Standards as specified and indicated on the drawings. Make fixture parts and components not specifically identified or indicated on the drawings, of materials most appropriate to their use or function, and resistant to corrosion and to thermal and mechanical stresses encountered in the normal application and function of the fixtures.

2.2 MARKING OF FIXTURES

A. Mark fixtures according to proper lamp type. Provide markings that are clear and readily visible to service personnel, but invisible from normal viewing angles when lamps are in place.

2.3 MATERIALS AND FABRICATION

A. Provide fixtures, completely factory assembled, wired, and equipped with necessary sockets, wiring, shielding, reflectors, channels, lenses and other parts and appurtenances necessary to complete the fixture installation and deliver to project site ready for installation.

2.4 FINISHES

A. The engineer shall select finishes and indicate the color selections on the shop drawing submittals.

2.5 FIXTURE WIRING

A. Provide wiring channels and wireways free from projections and rough or sharp edges throughout. At points or edges over which conductors shall pass and may be subject to injury or wear, round bush to make a smooth contact surface with the conductors.

B. Install insulated bushings at points of entrance and exit of flexible wiring.

2.6 LED LIGHT FIXTURES, DRIVERS, AND MODULES

A. Provide 0-10V dimming drivers for LED lamps that are suitable for the electrical characteristics of the supply circuits to which they are to be connected, and which are suitable for operating the specified lamps.

B. Provide dimming drivers conforming to UL, ETL and ANSI Specifications and displaying labels or symbols of approval by the UL or ETL and of certification as tested by the UL / ETL. Design, fabricate and assemble component parts of drivers in accordance with the latest requirements of the NEC. This Driver protection shall be provided by a built-in self-resetting thermally actuated device that shall remove the driver from line when excessive driver temperature is reached.

C. Rigidly mount drivers to the inside of the top of the fixture housing, with driver surfaces and housing in complete contact for efficient conduction of driver heat, unless specifically indicated to the contrary. Permanently affix driver mounting screws to the fixture housing. Provide only fixtures whose design, fabrication and assembly prevent overheating or cycling of LED’s and drivers under any condition of use.

D. Provide identical drivers within each fixture type unless otherwise noted.

E. Switched fixtures which incorporate battery inverter packs for emergency lighting circuits shall include a second "hot leg" conductor to allow for fixtures to be switched without activating the battery inverter pack. Battery inverter packs shall only be activated during loss of normal power.

F. LED light fixtures shall be Reduction of Hazardous Substances (RoHS) – compliant.

G. LED drivers shall include the following features unless otherwise indicated:

1. Minimum efficiency: 85% at full load

2. Minimum Operating Ambient Temperature: -20˚C (-4˚F).

3. Input Voltage: 120/277V (±10%) at 60Hz.

4. Integral short circuit, open circuit, and overload protection

5. Power Factor: ≥ 0.95.

6. Total Harmonic Distortion: ≤ 20%

7. Comply with FCC 47 CFR Part 15

8. Provide 0-10V dimming controls.

H. LED modules shall include the following features unless otherwise indicated:

1. Comply with IES LM-79 and LM-80 requirements.

2. Minimum color rendering index (CRI) 82.

3. Color temperature shall be 4100K unless otherwise specified in Lighting Fixture Schedule. Color temperature shifts shall comply with ANSI C78 377A for LED binning with further sub-binning restrictions of chromatic to be at or below the visual threshold of perceivable color variation not exceeding the 3 step MacAdam Ellipse line that crosses the black body locus as indicated on the LM79 report. Such restrictions documentation compliance shall be submitted as part of the submittal process.

4. Minimum Rated Life: 50,000 hours per IES L70

5. Light output lumens in accordance to the specified manufacturer and catalog number as indicated in the Lighting Fixture Schedule.

2.7 EXTERIOR FIXTURES

A. LED light fixtures shall be Reduction of Hazardous Substances (RoHS) – compliant.

B. LED drivers shall include the following features unless otherwise indicated:

1. Minimum efficiency: 85% at full load

2. Minimum Operating Ambient Temperature: -20˚C (-4˚F).

3. Input Voltage: 120/277V (±10%) at 60Hz.

4. Integral short circuit, open circuit, and overload protection

5. Power Factor: ≥ 0.95.

6. Total Harmonic Distortion: ≤ 20%

7. Comply with FCC 47 CFR Part 15

8. Provide 0-10V dimming controls.

C. LED modules shall include the following features unless otherwise indicated:

1. Comply with IES LM-79 and LM-80 requirements.

2. Minimum color rendering index (CRI) 82.

3. Color temperature shall be 4100K unless otherwise specified in Lighting Fixture Schedule. Color temperature shifts shall comply with ANSI C78 377A for LED binning with further sub-binning restrictions of chromatic to be at or below the visual threshold of perceivable color variation not exceeding the 3 step MacAdam Ellipse line that crosses the black body locus as indicated on the LM79 report. Such restrictions documentation compliance shall be submitted as part of the submittal process.

4. Minimum Rated Life: 50,000 hours per IES L70

5. Light output lumens in accordance to the specified manufacturer and catalog number as indicated in the Lighting Fixture Schedule.

D. Provide fixtures with 0-10V dimming drivers and wireless control hubs, designed and manufactured specifically for outdoor service. Make components, including nuts, bolts, rivets, springs, and similar parts, of materials of effective corrosion resistance, or of materials which have been subjected to finishing treatment which shall ensure such resistance.

E. Provide fixtures for use outdoors or in areas designated as wet or damp locations, which are suitably and effectively gasketed to prevent access of moisture into electrical components or enclosing diffusers, lenses or globes.

F. Provide metal parts of fixtures for use in outdoor, wet or damp locations which are specified as requiring painting with suitable weather and moisture resisting qualities equal to epoxy-based coatings.

G. Provide anodized aluminum for aluminum parts of exterior fixtures which are not specified as requiring a painted finish.

H. Poles:

1. Poles shall be provided in accordance with the Lighting Fixture Schedule.

2. Pole finish shall match that of the light fixture.

3. Furnish light pole bolt template/pattern to concrete pole foundation/base supplier. Coordinate with General Contractor.

2.8 FIXTURE DESCRIPTION

A. Provide fixtures that conform to the above Standards and criteria as indicated on the drawings.

2.9 LUMINAIRES SCHEDULE

A. Refer to plans for Luminaires Schedule.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine excavation and concrete foundation for lighting poles.

B. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lighting poles at locations indicated.

C. Install poles plumb. Double nuts to adjust plumb. Grout around each base.

D. Install lamps in each luminaire.

E. Bond luminaires, metal accessories and metal poles to branch circuit equipment grounding conductor. Provide supplementary grounding electrode at each pole for Type M roadway luminaires.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

B. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

A. Aim and adjust luminaires to provide illumination levels and distribution as directed.

B. Replace luminaires which have failed at Date of Substantial Completion.

3.5 CLEANING

A. Clean electrical parts to remove conductive and deleterious metals.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

END OF SECTION

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