PROJECT MANUAL

BOBCAT, FOX AND PORCUPINE, TRAILSIDE MUSEUMS AND ZOO

BEAR MOUNTAIN, NEW YORK

100% CONSTRUCTION DOCUMENTS WITH ALTERNATES

2 April 2021

Landscape Architect & Habitat Design	Coyle & Caron Inc. Orlando, FL
Architect	klmARCHITECT Goshen, NY
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PROJECT MANUAL

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SECTION 011000

SUMMARY OF THE WORK

PART 1 GENERAL

1.01 WORK COVERED BY THE CONTRACT DOCUMENTS

A. The Contractor shall provide all material and labor necessary to perform all site work associated with the project as shown on the contract documents. This project consists of a base bid and three alternate construction elements for three new animal exhibits. The Scope of Work for this Contract shall include, but is not limited to, all labor, materials, equipment, and incidental expenses necessary to:

1. Clear and Grub
2. Install Water Lines from Adjacent Museum to (3) New Animal Exhibits.
3. Install Secondary Electrical Service Underground from Existing Service at Adjacent Museum.
4. Install Wastewater Systems for (3) New Exhibits.
5. Install Approx. 525 L.F. of temporary Perimeter Construction Fencing.
6. Construct trail path including subbase.
7. Construct wooden viewing deck at Bobcat Exhibit.
8. Construct view rails and fences.
9. Construct Visitor and Zookeeper Pathways to subgrade finish and Steps to animal night houses and enclosures.
10. Construct (2) animal night houses and a concrete pad for a third.
11. Construct one woven wire mesh animal enclosures (for Bobcat), and one fenced area for red fox.
12. Construct (1) Porcupine Exhibit with Stone, Boulder, and Tempered Glass Containment Wall.
13. Construct water features for Bobcat, Red Fox and Porcupine Exhibits.
14. Place Suitable Fill and Topsoil to Grades indicated on Contract Drawings.

15. Gather and Place Onsite Boulders and logs as Directed by Owners Representative.

16. Construct and Install any related site appurtenances as shown on the Contract Drawings.

17. Install and maintain all erosion control devices until all site work is completed, and then have them removed from site.

18. The contractors' attention is drawn to the following specialized qualifications for sub- contractors performing the work. Costs reflecting these requirements need to be factored into the contractors bid price:

    a. Section 015639 Temporary Tree Plant Protection

        1.5 Quality Assurance

            A. Tree Service Firm Qualifications

    b. Section 033715 Sprayed and Carved Concrete (Artificial Rockwork)

        1.06 Quality Assurance

            A. The Contractor for the artificial rockwork shall be an established firm with the following minimum level of experience:

            Items 1.-5. Requires (7) years' experience for each.

    c. Section 131700 Water Feature Plumbing

        1.02 Quality Assurance

            A. Qualifications: The persons performing the Work of this section and their supervisor shall have been regularly performing such work for a minimum of 5 years.

    d. Section 07123 Field Engineering

        1.06 Survey Requirements

            A. Qualifications: Contractor is to employ a New York Licensed Land Surveyor for lay out and as-built work. Parks will provide the contractors land surveyor with survey base line points, coordinates, elevations, and design CAD files.

B. Type of Contract: **Lump Sum**

1.02 PHYSICAL COMPLETION DATE

A. Physically complete construction elements of the Work within **365** days after the Agreement is approved by the Commission.

1. The approval of the Agreement by the Commission constitutes the filing of the Contract Documents as a public record and notice to the Contractor that a fully executed contract exists between the Contractor and the Commission.

B. Liquidated damages of **$1,750/day** after this time for delays, within the Contractor's control, will be deducted from the Contract amount. The Contractor shall demonstrate to the Director's Representative that the above time period can be met prior to starting the Work.

1.03 ITEMS NOT INCLUDED

A. The following items shown on the drawings are not included in this Contract:

1. Animal night house interior caging, sliding doors, and cage fixtures.
2. Building materials to be provided, shall include exterior stone and wood trim for night houses and synthetic roof slate.
3. Any other Items indicated "NIC" (Not in Contract).

1.04 DRAWINGS

A. The Contract Drawings which accompany this Project Manual form a part of the Contract Documents.

1.05 CONTRACTOR USE OF PREMISES

A. Work hours shall be 7:00 a.m. to 5:00 p.m., Monday through Friday, unless otherwise approved in writing by the Director's Representative.

B. Movement of large equipment and delivery of materials shall be done before 10 am, when the facility opens to the public, unless arranged otherwise with the Director's Representative or Facility Manager.

C. Inform the Director's Representative of work area access requirements. The Director's Representative will coordinate and schedule the requirements with Facility staff to obtain and ensure timely availability of work areas.

D. Contractor shall be responsible to restore any/all pathways and adjacent disturbed areas along routes of Ingress and Egress to access the project site to their preconstruction conditions. These pathways shall remain open and functional during all construction

activities.

E. Be responsible and accountable for employees, suppliers, subcontractors and their employees, with regard to their use of the premises. Direct them to comply with the Facility Regulations and with the security and traffic regulations

F. Furnish the Director's Representative with a telephone number or method to contact the supervisor for the Work in case of an emergency after work hours, including weekends and holidays.

G. Comply with applicable federal and State of New York Right-to-Know Law provisions and supply copies of the appropriate Material Safety Data Sheets (MSDS) to the Director's Representative.

H. Direct employees to be watchful for people in or near the work area where safety hazards may be present. Notify the Director's Representative or Facility Manager, if necessary, to remove them from the work area or Site.

I. Report fire and other emergency situations to the Director's Representative/Security Department immediately.

1.06 FACILITY REGULATIONS

A. The following items are not allowed on the Site or on Facility premises.

1. Firearms, ammunition, weapons, and dangerous instruments (other than tools required for the Work).

2. Alcoholic beverages and persons under the influence of same.

3. Illegal controlled substances and person under in the influence of same.

1.07 REFERENCE SPECIFICATIONS AND STANDARDS

A. Comply with the requirements of the various specifications and standards referred to in these Specifications, except where they conflict with the requirements of these Specifications. Such reference specifications and standards shall be the date of latest revision in effect at the time of receiving bids, unless the date is given.

B. DOT Specifications: If the abbreviation DOT appears in these Specifications, it shall mean the New York State Department of Transportation, Office of Engineering specifications entitled "STANDARD SPECIFICATIONS - CONSTRUCTION AND MATERIALS" dated January 2, 2008, including all applicable Addenda in effect at the time of receipt of bids. The DOT specifications may be purchased from the Department of Transportation, Business Administration Bureau, Building No. 5, Room 109, State Office Building Campus, Albany, NY 12232.

1.08 LAYING OUT

A. Examine the Contract Documents thoroughly and promptly report any errors or discrepancies to the Director's Representative before commencing the Work.

B. Lay out the Work in accordance with the Contract Documents, as well as directed on-site by the Director's Representative.

1.09 RESPONSIBILITIES OF THE CONTRACTOR

A. Except as otherwise specifically stated in the Contract Documents and detailed specifications, the Contractor shall provide all materials, labor, tolls, equipment, transportation, superintendence, temporary construction of every nature, charges, levies, fees, or other expenses incurred and all other services and facilities of every nature whatsoever necessary for the performance of the Contract within the specified time frame.

B. It shall remain the Contractor's responsibility to ensure that all required permits and/or approvals for the work have been obtained prior to beginning of construction. There shall also be no additional costs added to the contract if construction is delayed in the processing and obtaining of all such permits.

1.10 CLEANING UP

A. Clean up and containerize the rubbish (refuse, debris, waste materials, and removed materials and equipment) resulting from the Work at the end of each work day and leave work areas clean. Locate containerized rubbish where directed.

B. Remove piled rubbish from State property at least once a week or more often if the rubbish presents a hazard. Properly dispose of rubbish. Burning of rubbish will not be permitted.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 012100

ALLOWANCES

PART 1 GENERAL

1.01 DESCRIPTION

A. Include in the contract sum the allowances stated in this Section.

B. Should the net cost be more than the specified amount of the allowance, the contract sum will be adjusted by Order on Contract in accordance with the General Conditions. No Work more than the allowance will be permitted except by Order on Contract. Should the net cost be less than the specified amount of the allowance, the balance will be deducted from the final payment.

1.02 ALLOWANCE FOR CONTINGENCIES

A. Include in the contract sum the amount indicated below to cover the cost of additional labor and materials for contingent activities within the scope of the Contract as directed in writing by Field Order. The Field Order will include a description for the Work and a method for determining the cost of such Work.

1. General Contract: $43,700.00

B. The value of the directed Work under this allowance will be determined by one or more of the following methods which will be specified in the Field Order:

1. By accepting an amount agreed upon by both parties, such amount to be calculated in a manner similar to that described in subparagraph 3. below.

2. By applying the applicable price or prices set forth in the Contract Documents or by applying a unit price agreed to by both parties.

3. By estimating the fair and reasonable cost of: (1) labor including all wages, required wage supplements and insurance required by law (workers' compensation, social security, disability, unemployment, etc.) paid to or on behalf of foremen, workers and other employees below the rank of Contractor's designated representative directly employed at the Site, and, on contracts with an award price less than $1,000,000, the Contractor's designated representative, regardless of job title or work status; (2) materials; (3) equipment, excluding hand tools, which, in the judgment of the State, would have been or will be employed exclusively and directly on the omitted work or extra work, as the case may be; (4) all required bonds and Liability and Fire Insurance Premiums, whether

required by this Contract or a subcontract between the Contractor and a subcontractor actually performing the extra work; and (5) where the same is performed directly by the Contractor, by adding to the total of such estimated costs a sum equal to 15% thereof, but, where the extra work is performed by a subcontractor, by adding a sum equal to 15% of said costs for the benefit of such subcontractor, and by adding, for the benefit of the Contractor (no further allowance will be made where extra work is performed by the sub-subcontractor), an additional sum equal to 10% of the first $10,000 of the above estimated costs, including the subcontractor's percentage override, plus 5% of the next $90,000 of the total of said items, plus 3% of any sum in excess of $100,000 of the total of said items. For the purposes of the aforesaid percentage overrides, the reductions enumerated shall be applied to each Field Order issued on a Contract. A Field Order may include the work of one or more trades and/or subcontractors or sub-subcontractors and shall include all labor, material, plant, equipment tools and all incidentals directly and/or indirectly necessary, related, involved in or convenient to the successful completion of the extra work. Where the written description of the Field Order involves both an increase and a reduction in similar or related work, the above percentage overrides will be applied only on the amount, if any, the cost of the increased work exceeds the cost of the reduced work. All profit, overhead, and expenses, other than those set forth in the foregoing items (1) through (4), of the Contractor, its subcontractors, and sub-subcontractors, are covered by the aforesaid percentage overrides and no additional payment thereof will be made by the State.

4. By determining the actual cost of the extra work in the same manner as in the foregoing subparagraph 3. except that actual costs of the Contractor will be utilized in lieu of estimated costs. The State reserves the right to utilize this method provided it notifies the Contractor of its intent to do so prior to the time the Contractor is properly authorized to commence performance of such work.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 012300

ALTERNATES

PART 1 – GENERAL

1.01 GENERAL REQUIREMENTS

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

1.02 DESCRIPTION OF WORK

A. Work Included: This Section specifies administrative and procedural requirements for Alternates.

B. Coordination: Coordinate related Work and modify or adjust adjacent Work as necessary to ensure that Work affected by each Alternate is complete and fully integrated into the project.

C. Notification: Immediately following the award of the Contract, prepare and distribute to each party involved, notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred for consideration at a later date. Include a complete description of negotiated modifications to Alternates.

D. Schedule: A “Schedule of Alternates” is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the Work described under each Alternate.

PART 2 – PRODUCTS (Not used)

PART 3 – EXECUTION

3.1 SCHEDULE OF ALTERNATES

ALTERNATE #1 – Fox Habitat – Fenced Enclosure & Night House Pad
Refer to Sheets: C1, L1.10, L2.10, L3.10, L6.11, P1.00, E1.00

Refer to Details: 2/L7.10, 2/L8.10, 4/L8.10, 8B/L8.11, 1A/L8.12, 1B/L8.12, 2/L8.12

Specifications: Section 323113

ALTERNATE #2 – Porcupine Habitat
Refer to Sheets: C1, L1.10, L2.10, L3.10, P1.00, E1.00, A3.00, A3.10

Refer to Details: 3/L7.10, 8/L8.10, 8A/L8.10, 9/L8.10, 10/L8.10, 11/L8.10, 12/L8.10, 3/L8.11, 4/L8.11, 5/L8.11, 10/L8.11, 1/E2.00, 7/L8.12, 9/L8.12

Specifications: Section 088100, Section 313730

ALTERNATE #3 – Water Features (Bobcat, Fox, and Porcupine Habitats)
Refer to Sheets: L1.10, L2.10, L8.20, L8.21, L8.22

Specifications: Section 033715

END OF SECTION

SECTION 013113

PROJECT SCHEDULE

PART 1 GENERAL

1.01 RELATED REQUIREMENTS AND INFORMATION SPECIFIED ELSEWHERE

A. Project Meetings: Section 013119.

B. Submittals: Section 013300.

1.02 DEVELOPMENT OF THE PROJECT SCHEDULE

A. The Contractor will develop the Project Schedule and present it to the Director's Representative for review and acceptance.

1.03 MAINTAINING SCHEDULE

A. Perform the Work in accordance with the Project Schedule and provide resources necessary to maintain the progress of activities as scheduled so that no delays are caused to other Contractors engaged in the Work.

B. Should any Contractor fail to maintain progress according to schedule or cause delay to another Contractor, that Contractor shall provide such additional manpower, equipment, additional shifts, or other measures as directed to bring the operations back on schedule.

1.04 SCHEDULE RELATED REPORTING

A. Detailed Estimate: Refer to Section 013300.

B. Application for Payment: Prepare forms and support documentation in a manner compatible with the Detailed Estimate. Show costs in support of activities progressed in the Project Schedule status updates. Percentage completion amounts must reflect accepted work in place as agreed upon by the Director's Representative and documented in project meeting schedule status reports.

C. Labor Resource and Crew Utilization Reports: Submit weekly to the Director's Representative.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 013119

PROJECT MEETINGS

PART 1 GENERAL

1.01 INITIAL JOB MEETING

A. The Director's Representative will notify all parties concerned of the time and place of the initial job meeting.

B. The meeting will be conducted by the Director's Representative.

1.02 BI-WEEKLY JOB MEETINGS

A. Unless otherwise directed, job meetings will be held every two weeks at a time and place agreed upon by the Director's Representative and the Contractor. Other interested parties may attend when needed, e.g., construction administrator, subcontractors and representatives from suppliers, public utilities, and local government.

B. The meetings will be conducted by the Director's Representative for the following purposes:

1. Review job progress, quality of Work, and approval and delivery of materials.

2. Identify and resolve problems which impede planned progress.

3. Coordinate the efforts of all concerned so that the project progresses on schedule to on time completion.

4. Maintain sound working relationships between the Contractors and the Director's Representative, and a mutual understanding of the project requirements.

5. Maintain sound working procedures.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 013300

SUBMITTALS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Other provisions pertaining to submittals are included in the General Conditions and in various sections of the specifications.

1.02 SUBSTITUTIONS FOR BRAND NAMED PRODUCTS

A. Whenever a product is specified by brand name, a substitute brand, equal to that named, may be submitted for approval subject to the requirements of Article 5 of the General Conditions.

1. Whenever a color is indicated by a specific manufacturer's color name or number, the intent is to communicate the required color of the material. Other manufacturers' comparable colors may be submitted for approval as equal.

1.03 WAIVER OF CERTAIN SUBMITTAL REQUIREMENTS

A. Unless otherwise specified, the requirement to submit product data and samples for approval will be waived for products specified by brand name if the specifically named products are furnished for the Work. In such cases, furnish two copies of required Product Data to the Director's Representative for information only.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Identify all submittals by project title and number. Include Contractor’s name, date, and revision date. On shop drawings, product data and samples, also include name of supplier and subcontractor (if any), and applicable specification section number. Stamp each submittal and initial or sign the stamp to certify review and approval of submittal.

1.05 SHOP DRAWINGS

A. Submit 4 copies of each shop drawing required by the Specifications. Show the information, dimensions, connections, and other details necessary to ensure the shop drawings accurately interpret the Contract Documents. Show adjoining construction in such detail as required to indicate proper connections. Where adjoining connected construction requires shop drawings or product data, submit such information for approval at the same time so that connections can be accurately checked.

B. Have shop drawings prepared by a qualified detailer. Shop drawings shall be

neatly drawn and clearly legible.

C. The shop drawings will be reviewed, and 2 stamped copies returned. If returned copies are stamped "DISAPPROVED" or "RETURNED FOR CORRECTION", promptly resubmit 4 copies of shop drawings meeting Contract requirements.

1.06 PRODUCT DATA

A. Submit 4 copies of each item of product data required by the Specifications. Modify product data by deleting information which is not applicable to the project or by marking each copy to identify pertinent products. Supplement standard information, if necessary, for applicability to project.

B. The product data will be reviewed, and 2 stamped copies returned. If returned copies are stamped "DISAPPROVED" or "RETURNED FOR CORRECTION", promptly resubmit 4 copies of product data meeting Contract requirements.

1.07 SAMPLES

A. Submit 1 (unless a different number is specified) of each sample required by the Specifications. Samples shall show the quality, type, range of color, finish, and texture of the material intended to be furnished for the Work.

B. Samples will become the property of the State when submitted unless specifically stated otherwise and will not be incorporated in the Work.

1.08 SCHEDULES AND RECORDS

A. Forms will be supplied by the State for the following schedules and records. Complete the forms as required and submit them not later than 15 days after approval of the Contract unless the Contractor or the Director determines an earlier submission is required to properly schedule or progress the Work.

1. PROGRESS SCHEDULE: Submit anticipated project schedule to the Director’s Representative prior to beginning work, for his review, comments, and/or approval.

2. SCHEDULE OF SUBMITTALS: Indicate in the spaces following each item, the date the item will be submitted, the date approval is required (allow at least 3 weeks), and the date delivery of the material or equipment is necessary for timely completion of the Work in accordance with the Progress Schedule. The date entered for submittal of each item is the last day a substitution will be considered. Proposed substitutions must be made prior to the date entered if more than one substitution is to be submitted for approval.

3. CONTRACTOR'S LIST OF SUBCONTRACTORS: Indicate the items of

Work proposed to be accomplished by subcontractors, the name and address of each proposed subcontractor and the date proposed to award each subcontract, the dollar value of the subcontract, and Minority and Women-Owned Business Enterprise information. Attach a properly completed and executed New York State Uniform Contracting Questionnaire for each subcontractor whose subcontract is valued at $10,000.00 or more.

4. CONTRACTOR'S LIST OF SUPPLIERS: Indicate the names and addresses of proposed suppliers, the dollar value of the supplies, date of purchase order issuance, and Minority and Women-Owned Business Enterprise information.

B. If after initial approval, circumstances require a change in a subcontractor or supplier or require additional subcontractors or suppliers to be used, submit revised forms to reflect the changes or additions.

1.09 DETAILED ESTIMATE

A. Submit a detailed estimate of quantities and prices for materials, labor and other items required for the Work, which shall add up to the contract amount, no later than 10 days after the Initial Job Meeting. Prepare the detailed estimate in the same sequence as the Project Manual Table of Contents, beginning with the General Conditions. Indicate the material and labor costs separately for each item of Work.

B. The detailed estimate shall be supported by such evidence, including certified copies of subcontracts, as the Director may require.

C. The detailed estimate must be approved by the Director who may revise it as, in his reasonable judgment, is necessary to make the various items conform to their true values. The value of each requisition for payment shall be based on the approved detailed estimate.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 014100

REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 CODES

A. Comply with the requirements of the various codes referred to in these specifications, except where they conflict with the requirements of these specifications. The referenced codes shall be the date of latest revision in effect at the time of receiving bids unless the date is given.

B. Electrical Work: Conform to the requirements of the latest edition of the National Electrical Code (NEC) unless otherwise shown or specified. The Director's Representative will be the sole judge of the interpretation of these rules and requirements.

1.02 LISTINGS

A. Equipment and materials for which Underwriters' Laboratories, Inc. (UL) provides product listing service, shall be listed, and bear the listing mark.

1. Alternately, ETL Testing Laboratories, Inc. Product Safety Testing Listing is acceptable if the listed product has been tested to the applicable UL Standard.

1.03 UTILITY WORK WITHIN TRAILSIDE ZOO FACILITIES

A. Notify PIPC Water and Sewer Department 48 hours prior to beginning any Utility Work, either overhead or underground. (Carl Obermeyer, 845 786-2701)

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 015713

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 RELATED SECTIONS

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to the following:

1. Appendix A – New York State Department of Transportation Standard Sheet No. 209-05: Construction Entrance / Exit from EB 17-001.

1.02 RESPONSIBILITY

A. Assume responsibility for the temporary control of soil erosion and water pollution resulting from performance of the work of this contract.

B. In the event of conflict between these specifications and the regulation of other Federal, State, or local jurisdictions, the more restrictive regulations shall apply.

1.03 DESCRIPTION

A. The Work shall consist of installation and continual monitoring with repair of erosion control measures as shown on the Plans (Sheet L0.03), and as required or directed by the Director's Representative - toward providing adequate control of soil erosion and/or water runoff pollution.

B. Temporary measures shall include silt fences, hay bale dikes, stone construction entrance, sedimentation basins, silt screens, mulches, temporary seeding, and/or any other erosion control device or method as required and shown with the details.

1.04 AUTHORITY

A. The Director's Representative has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate temporary or permanent erosion or pollution control measures to minimize damage to property and contamination of watercourses and water impoundments.

1.05 COORDINATION AND SCHEDULING

A. Schedule the work to minimize the time that raw earth areas will be exposed to erosive conditions.

B. Coordinate the use of temporary controls with the permanent erosion control features or finish materials shown.

C. Incorporate permanent control features into the work at the earliest practical time.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 015526

SAFTEY & TRAFFIC CONTROL

PART 1 GENERAL

1.01 SUMMARY

A. The Work of this section consists of the following:

1. Maintaining pedestrian traffic and protecting the public from damage to persons and property along the site access road.

2. Closure of public access points to said road when moving equipment and delivering materials to the site during zoo operating hours.

3. Supplying one flag person to escort construction vehicles along said access road for ingress and egress to the site during zoo operating hours.

4. Installing “DANGER CONSTRUCTION ZONE DO NOT ENTER” signage and barriers at key entry point to the site.

5. Installing (1) “CAUTION CONSTRUCTION VEHICLES ENTERING ROADWAY” Sign along the northbound travel lane of US 9W.

6. Supplement to the National Manual on Uniform Traffic Control Devices for Streets and Highways – 2010 Edition (NYS Supplement) available at: https://www.nysdot.gov/divisions/operating/oom/transportation-systems/traffic-operations-section/mutcd

1.02 APPLICABILITY

A. The Work of this Section shall be required in all areas within the project limits that will be open to public.

1.03 RESPONSIBILITY

A. Assume responsibility for conducting operations in a manner to ensure the safety and convenience of all travelers and adjoining property owners within the limits of and for the duration of the contract.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with the requirements of DOT Section 700 Materials as they apply to the various materials required for the Work of this Section.

B. Provide sign panels of aluminum, galvanized steel or plywood with faces of reflective sheet material and non-reflective black characters conforming to DOT Section 730-13.

C. Provide delineators, barricades and lighting for construction barricades in accordance with the requirements of National MUTCD and NYS Supplement. Where reflective materials are required, conform to DOT Section 730-05.02 except where glass or plastic buttons are used as delineators. Barricades, cones and drums may use reflective materials conforming to DOT Section 730-05.01.

PART 3 EXECUTION

3.01 GENERAL

A. Remove construction equipment and materials from access roadway during non-working hours

B. Conduct and schedule the Work in a manner that will minimize the time during which the traveling public will be exposed to hazards.

C. Do not park employee's personal vehicles within the work area in a manner that they will constitute a hazard.

D. Keep traveled way reasonably smooth and hard at all times.

E. Keep the traveled way of all public highways utilized for hauling materials to or from this project free of foreign objects that may fall or drop from transporting vehicles.

F. Correct dusty conditions resulting from the Work by the use of calcium chloride and/or water. Distribute water uniformly by the use of suitable spray heads or spray bar. The Director's Representative will be the sole judge of the need for the application of water for dust control. Apply water at the intervals and locations ordered by the Director's Representative.

G. Whenever it becomes necessary to maintain traffic on one lane, provide adequate traffic controls on the section of roadway on which vehicle traffic is maintained. Provide competent flag persons or traffic signals at the location which will in the judgment of the Director's Representative adequately and continuously control one lane traffic.

H. Provide a sufficient number of competent flag persons in areas where construction operations are in potential conflict with public vehicular traffic. Flag person shall wear orange hats or caps and vests in conformance with National MUTCD and NYS Supplement.

I. Maintain safe and adequate ingress and egress to and from intersecting highways, internal roads and driveways.

J. Maintain existing and new drainage structures, culverts and ditches to adequately drain the traveled.

3.02 CONSTRUCTION SIGNS

A. Provide, maintain, move and remove reflectorized construction signs in accordance with the requirements of National MUTCD and NYS Supplement.

B. Paint supports and backs of sign panels with two coats of white paint.

C. Mount construction signs a minimum of 5 feet above the surface of the traveled way.

3.03 CONSTRUCTION BARRICADES

A. Provide, maintain, move and remove lighted construction barricades in accordance with the requirements of National MUTCD and NYS Supplement

B. Provide flashing barricade lights of Type A, low intensity conforming to the requirements of National MUTCD and NYS Supplement

C. Hours of operation for barricade lights shall be from dusk to dawn.

3.04 PAVEMENT DELINEATION

A. Provide pavement delineation in accordance with National MUTCD and NYS Supplement on each course of asphalt concrete upon which traffic will be maintained.

3.05 OPENING ROADWAY TO TRAFFIC PRIOR TO CONTRACT ACCEPTANCE

A. Maintain and protect traffic on any portion of pavement or structure ordered in writing by the Director or as shown on the drawings to be opened to traffic prior to contract acceptance.

3.06 REMOVAL OF TRAFFIC CONTROL DEVICES

A. Promptly remove all delineators, signs, barricades and pavement workings when in the opinion of the Director’s Representative their presence constitutes a hazard or inconvenience to the traveling public.

B. Remove all remaining traffic control devices upon completion of the Work of this contract unless otherwise ordered in writing by the Director’s Representative.

END OF SECTION

SECTION 015639

TEMPORARY TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary site fencing.
2. Section 311000 "Clearing and Grubbing" for removing existing trees and shrubs.

1.3 DEFINITIONS

A. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by a diameter tape at a height 54 inches above the ground line.

B. Plant-Protection Zone (PPZ): Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction. Limit to be determined by Director's Representative.

C. Tree-Protection Zone (TPZ): Area surrounding individual trees or groups of trees to be protected during construction Refer to drawings for trees to be protected, limit of TPZ to be determined by Director's Representative.

D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For ISA Certified arborist and tree service firm.

B. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.

C. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.

1. Use sufficiently detailed photographs or video recordings.
2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.5 QUALITY ASSURANCE

A. Tree Service Firm Qualifications: An ISA-Certified, experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

1.6 FIELD CONDITIONS

A. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Moving or parking vehicles or equipment.
3. Erection of sheds or structures.
4. Impoundment of water.
5. Excavation or other digging unless otherwise indicated.
6. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

B. Do not direct vehicle or equipment exhaust toward protection zones.

C. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs.

B. Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements:

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch maximum opening in pattern and weighing a minimum of 0.4 lb/ft. remaining flexible from minus 60 to plus 200 deg F inert to most chemicals and acids; minimum tensile yield strength of 2000 psi and ultimate tensile strength of 2680 psi secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 96 inches apart.

a. Height: 48 inches
b. Color: High-visibility orange, nonfading.

2. Gates: Single or Double swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches minimum.

C. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

B. Prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.2 PREPARATION

A. Locate and clearly identify trees, shrubs, and other vegetation to remain.

B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.

C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.

1. Apply a minimum of 4” uniform thickness of mulch unless otherwise indicated. Do not place mulch within **6 inches** of tree trunks.

3.3 PROTECTION ZONES

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones **before materials or equipment are brought on the site and construction operations begin** in a manner that will prevent people from easily entering protected areas except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
2. Access Gates: Install **as required;** adjust to operate smoothly, easily, and quietly; free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction throughout entire operational range.

Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every **50 feet o**n protection-zone fencing, but no fewer than [**four**] signs with each facing a different direction.

C. Maintain protection zones free of weeds and trash.

D. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
   1. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.4 EXCAVATION

A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Section 310000 "Earthwork" unless otherwise indicated.

B. Trenching within Protection Zones: Where utility trenches are required within protection zones, excavate under or around tree roots by hand or with air spade, or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only smaller roots that interfere with installation of utilities. Cut roots as required for root pruning. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots.

C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches back from new construction and as required for root pruning.

D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.5 ROOT PRUNING

A. Prune tree roots that are affected by temporary and permanent construction. Prune roots **as follows:**

   1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.

2. Cut Ends: **Do not paint cut root ends**
3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

B. Root Pruning at Edge of Protection Zone: Prune tree roots **flush with the edge** of the protection zone by cleanly cutting all roots to the depth of the required excavation.

C. Root Pruning within Protection Zone: Clear and excavate by hand or with air spade to the depth of the required excavation to minimize damage to tree root systems. If excavating by hand, use narrow-tine spading forks to comb soil to expose roots. Cleanly cut roots as close to excavation as possible.

3.6 CROWN PRUNING

A. Prune branches that are affected by temporary and permanent construction. Prune branches **as directed by arborist**.

1. Prune to remove only **injured,** broken, dying, or dead branches unless otherwise indicated. Do not prune for shape unless otherwise indicated.
2. Do not remove or reduce living branches to compensate for root loss caused by damaging or cutting root system.
3. Pruning Standards: Prune trees according to ANSI A300 (Part 1) **and as indicated on Drawings**.

B. Unless otherwise directed by arborist and acceptable to Directors Representative, do not cut tree leaders.

C. Cut branches with sharp pruning instruments; do not break or chop.

D. Do not paint or apply sealants to wounds.

E. Provide subsequent maintenance pruning during Contract period as recommended by arborist.

F. Chip removed branches and stockpile or **spread over areas approved by the Directors Representative**

3.7 REGRADING

A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.

1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.

C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

D. Minor Fill within Protection Zone: Where existing grade is **2 inches** or less below elevation of finish grade, fill with backfill soil. Place backfill soil in a single uncompacted layer and hand grade to required finish elevations.

3.8 FIELD QUALITY CONTROL

A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.9 REPAIR AND REPLACEMENT

A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or to be relocated that are damaged by construction operations, in a manner approved by Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours according to arborist's written instructions.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.

B. Trees: Remove and replace trees indicated to remain that are more than **50** percent dead or in an unhealthy condition **before the end of the corrections period** or are damaged during construction operations that Directors Representative determines are incapable of restoring to normal growth pattern.

1. Small Trees: Provide new trees of same size and species as those being replaced for each tree that measures **4 inches** or smaller in caliper size.
2. Large Trees: Provide **two** new tree(s) of **3-inch** caliper size for each tree being replaced that measures more than **4 inches** in caliper size.

    a. Species: **As selected by approved by Director’s Representative**

3. Plant and maintain new trees per the Director’s Representative.

C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a **3-inch** uniform thickness to remain.

D. Soil Aeration: Where directed by Director's Representative, aerate surface soil compacted during construction. Aerate **10 feet** beyond drip line and no closer than **36 inches** to tree trunk. Drill **2-inch-**diameter holes a minimum of 12 inches deep at **24 inches** o.c. Backfill holes with an equal mix of augered soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove excess excavated material, displaced trees, trash, and debris and legally dispose of them off Owner's property.

END OF SECTION

SECTION 015713

TEMPORARY EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.01 RESPONSIBILITY

A. Assume responsibility for the temporary control of soil erosion and water pollution resulting from performance of the work of this contract.

B. In the event of conflict between these specifications and the regulation of other Federal, State, or local jurisdictions, the more restrictive regulations shall apply.

1.02 DESCRIPTION

A. The Work shall consist of installation and continual monitoring with repair of erosion control measures as shown on the Plans (Sheet L0.03), and as required or directed by the Director's Representative - toward providing adequate control of soil erosion and/or water runoff pollution.

B. Temporary measures shall include silt fences, hay bale dikes, stone construction entrance, sedimentation basins, silt screens, mulches, temporary seeding, and/or any other erosion control device or method as required and shown with the details.

1.03 AUTHORITY

A. The Director's Representative has the authority to limit the surface area of erodible earth exposed by earthwork operations and to direct the Contractor to provide immediate temporary or permanent erosion or pollution control measures to minimize damage to property and contamination of watercourses and water impoundments.

1.04 COORDINATION AND SCHEDULING

A. Schedule the work to minimize the time that raw earth areas will be exposed to erosive conditions.

B. Coordinate the use of temporary controls with the permanent erosion control features or finish materials shown.

C. Incorporate permanent control features into the work at the earliest practical time.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 016500

MATERIALS AND EQUIPMENT

PART 1 GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Specific requirements pertaining to materials and equipment specified elsewhere are additional to the provisions of this Section.

1.02 PRODUCT LABELS

A. When materials or equipment are specified to conform to ASTM, Federal or other reference specifications, the materials delivered to the site shall bear the manufacturer's printed labels stating that the materials meet the requirements of such referenced specifications.

1.03 TRANSPORTATION AND HANDLING

A. Deliver factory packaged materials and equipment in the manufacturer's original containers.

B. Transport and handle materials and equipment in such a manner as to prevent their damage.

C. Arrange for delivery of materials and equipment during the hours of the day established by the Director's Representative.

D. Have workers available to receive and unload materials and equipment delivered to the site. Do not deliver, or have delivered, any materials and equipment to the site unless such forces are available.

E. Facility personnel are not authorized to sign for receipt of Contractor's material or equipment.

1.04 STORAGE AND PROTECTION

A. Neatly pile, store, protect, and secure materials and equipment in locations where directed.

B. Protect materials and equipment subject to damage by temperature or other weather conditions.

C. Do not store volatile liquids in a State building.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 017000

CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Other provisions pertaining to this Section are included in Article 9 of the General Conditions.

1.02 CONTRACT CLOSEOUT INSPECTIONS

A. The following 3 inspections will be made in addition to the normal inspections to ensure that all Contract requirements are met and that the Work is complete and acceptable. The purpose of each of these inspections is to furnish the Contractor a written list of Contract exceptions, omissions, and incompletions so that the Work can be progressed to timely completion in accordance with the Contract Documents.

1. Detailed Inspection: The "Detailed Inspection" will be made when the Work is substantially complete. A copy of the detailed inspection list will be furnished to the Contractor. When this inspection progresses over any length of time, copies of the list will be furnished as the inspection progresses so that the Contractor may proceed with the required Work without delay.

2. Final Inspection: The Contractor will be advised by letter of the date and time of final inspection. A copy of the final inspection list containing all incomplete or unsatisfactory items and the time allowed to complete the Work will be furnished to the Contractor.

3. Joint Inspection for Physical Completion: The joint inspection for physical completion will be made to verify completion of the exception items listed on the final inspection list so that the physical completion date (defined in the General Conditions) may be established.

1.03 FINAL CLEANING

A. Perform final cleaning prior to joint inspection for physical completion. Leave the premises in a neat, unobstructed condition, the work areas broom clean (except where more thorough cleaning is specified), and everything in perfect repair and adjustment.

B. Clean site: sweep paved areas, rake clean landscaped surfaces, and remove all temporary erosion control devices that were installed (unless directed to have them remain via the Director’s Representative).

C. Remove tools, equipment, waste and surplus materials, rubbish, and construction facilities from the premises as soon as possible upon completion of the Work.

D. Prior to contract closeout the access road, materials, and equipment staging areas must be restored equal to, or better than pre-construction conditions at the contractor’s expense and at no additional cost to the state.

1.04 PROJECT RECORD DOCUMENTS

A. Maintain on site, 2 sets of the following record documents; record actual revisions to the Work:

1. Contract Drawings.

2. Project Manual.

3. Addenda.

4. Change Orders and other modifications to the Contract.

5. Reviewed shop drawings, product data, and samples.

B. Store record documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Project Manual: Legibly mark and record in Part 2 of each Section of the Specifications, a description of the actual products installed, including the following:

1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.

3. Changes made by addenda and modifications.

E. Record Documents and Shop Drawings: Legibly mark, on clean white backed bond paper, each item to record actual construction including:

1. Measured depths of foundations in relation to finish (first) (main) floor datum.

2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

3. Measured locations of internal utilities and appurtenances

concealed in construction, referenced to visible and accessible features of the Work.

4. Field changes of dimension and detail.

5. Details not on original Contract Drawings.

F. Upon completion of the Work, turn over the project record documents to the Director's Representative.

G. Applications for progress payments will not be approved if the record documents are not kept current. Application for final payment will not be approved until the project record documents are delivered to the Director's Representative.

1.05 OPERATION AND MAINTENANCE DATA (AS APPLICABLE)

A. Prepare 2 sets comprised of 8-1/2 x 11-inch text pages bound in capacity expansion binders with durable plastic covers identified with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required. Prepare a printed Table of Contents for each volume, with each product or system description identified. Internally subdivide the binder contents with permanent page dividers, logically organized as described below, with tab titles clearly printed under reinforced laminated plastic tabs:

Part 1: Directory, listing names, addresses, and telephone numbers of Contractor, subcontractors, and major equipment suppliers.

Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:

1. Significant design criteria.

2. List of equipment.

3. Parts list for each component.

4. Operating instructions.

5. Maintenance instructions for equipment and systems.

6. Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

Part 3: Project documents and certificates, including the following:

1. Shop drawings and product data.

2. Air and water balance reports.

3. Certificates.

4. Photocopies of warranties.

B. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned after final inspection, with the Director's comments. Revise content of documents as required prior to final submittal.

C. Submit 2 volumes prior to final Application for Payment.

1.06 WARRANTIES

A. Furnish warranty certification and copies of warranties which extend beyond the one-year period required by the General Conditions. Warranties submitted without warranty certification will not be accepted.

1. Warranty Certification: Written certification from the warrantor that invoices for installation, service, supplies, and warranty fees have been paid in full to persons or firms due payment, and that the warranty is in effect and non- retractable due to any of the specified conditions.

B. Prepare printed Table of Contents and assemble warranty certifications and warranty copies in a binder with a durable plastic cover.

C. Deliver the binder to the Director's Representative prior to final Application for Payment.

D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, indicating date of acceptance as start of warranty period.

E. Applications for final payment will not be approved until the warranty certification and warranty documents are delivered to the Director's Representative.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 017123

FIELD ENGINEERING

PART 1 GENERAL

Contractor is to employ a New York Licensed Land Surveyor for field survey work as outlined in this section. Parks will provide the contractor's land surveyor with survey base line points, coordinates, elevations, and design CAD files.

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Contract Closeout: Section 017716.

1.02 TOOLS, EQUIPMENT, AND MATERIALS

A. Furnish all tools, equipment, and materials required to perform the work of this Section.

B. Permanent Survey Markers: Conform to D.O.T. Section 626, Survey Markers.

1.03 EXAMINATION

A. Identify key locations, develop, and install a series of permanent control reference points throughout the site.

B. Promptly notify Director's Representative of any hindrance to this required task.

1.04 CONTROL POINTS

A. A control datum for survey is indicated on the Drawings.

B. Prior to construction the contractor's Land Surveyor is to establish (3) field survey control points. (2) outside the site and (1) within the site.

C. Replace dislocated control points based on original survey control. Make no changes without prior written notice to the Director's Representative.

D. Protect and preserve control points before, during, and after construction operations. Locate these points out of areas potentially disturbed by subsequent phased operations.

E. Promptly report to Director's Representative the loss or destruction of any control point or relocation required because of changes in grades or other reasons.

F. Replace dislocated control points based on original survey control. Make no changes without prior written notice to the Director's Representative.

1.05 ESTABLISHING CONTROL POINTS

A. Prior to clearing or earthwork operations, verify and install a minimum of 2 permanent survey markers at critical locations within the Work, and as approved by the Director's Representative. Establish and record the exact coordinates of these markers to within one one-hundredth of a foot horizontally.

B. Reference coordinates and elevations to the horizontal and vertical datum provided for this contract.

C. Locate each permanent survey marker from at least 3 points of permanent reference.

D. At the completion of the project the contractor's Land Surveyor is to provide parks within (3) permanent field survey base line control points with a clear line of site between each in the horizontal and vertical datums as that of the existing conditions survey and an electronic point file in .txt format in Point Number, Northing, Easting, Elevation, and Description configuration.

E. Said control points to be set to the satisfaction of the Parks Land Surveyor.

1.06 SURVEY REQUIREMENTS

A. Construction Stake Out (Field Survey Stakeout)

1. The contractors land surveyor will provide location stakes and (2) offset stakes with grades for the following:

a. All Points of Curve (PC,) Midpoints of Curve, and Points of Tangency (PT) for each horizontal tangent curve on the plan including Point of Reverse Curves (PRC) and Point of Compound Curves (PCC)

b. Provide location and (2) offset stake with grades for roadways, walks, concrete pads, drainage structures retaining walls, columns, footings, and utilities.

B. Utilize recognized engineering survey practices.

C. Establish a minimum of two permanent survey markers to be used as benchmarks for vertical control on the Site where indicated on the Drawings and referenced to established control points. Record locations, with horizontal and vertical data to within one one-hundredth of a foot, on Project Record Documents.

D. Establish elevations, lines, and levels. Locate and lay out by instrumentation and similar appropriate means:

1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.

2. Future building foundation corners and ground floor elevations.

E. Verify limits of construction by same means.

1.07 FIELD ENGINEERING FOR GENERAL EARTHWORK

A. Provide not less than one stake for each 2,500 square feet where rough and finished grades are flatter than one foot of rise per 10 feet of run.

B. Provide not less than one stake for each 2,000 square feet where rough and finished grades are greater than one foot of rise per 10 feet of run but less than one foot of rise per 4 feet of run.

C. Provide not less than one stake for each 1,000 square feet where rough and finished grades are greater than one foot of rise per 4 feet of run.

D. Provide stakes spaced not more than 50 feet apart along centerline of ditches and swales. Provide additional stakes at right angles to centerline, and opposite each centerline stake, to mark bottom and top of slopes.

E. Mark each stake with the correct finished grade elevation and the appropriate cut or fill at that stake.

1.08 FIELD ENGINEERING FOR DRAINAGE STRUCTURES, PIPES, CULVERTS, AND TUNNELS

A. Drainage Structures: Provide stakes marked with inverts. Also mark structure number if indicated on Drawings.

B. Pipes, Culverts, and Tunnels: Provide stakes at each end marked with inverts.

1.09 FIELD ENGINEERING FOR CHANNELS AND ROADWAY STRUCTURES

A. Channels: Provide stakes at centerline of channel at each side of roadway structure.

B. Roadway Structures: Stake centerline of structural bearing points, footings, anchor bolts, and other features.

1.10 FIELD ENGINEERING FOR ROADWAYS AND PAVING WORK

A. Place two offset stakes at each centerline station (50-foot intervals) and at tangent points, radius points, abrupt changes in grade, super-elevation, and other locations necessary to maintain layout and grade control.

B. Mark each stake with the correct centerline station number, description,

offset and cut or fill.

C. Restore faded or illegible markings.

D. Provide pins and hubs directly adjacent to the Work at a spacing of 25 feet. Mark pins and affix string lines to provide adequate horizontal and vertical control for paving work.

E. Immediately following placement of the final paving course, and prior to project closeout, re-establish and mark the location of all centerline stations with masonry nails at least 2 inches long. Drive nail heads flush with the pavement surface.

F. For points of curve and tangent points, provide identifying markings at the outside edge of each lane.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 017124

AS-BUILT PLANS

PART 1 GENERAL

RELATED WORK SPECIFIED ELSEWHERE

1. Contract Closeout: Section 017000

2. Field Engineering: Section 017123

1.01 AS-BUILT PLANS

1. The contractor is to engage an independent NYS Licensed Land Surveyor to produce final As-Built plans

2. The word "independent" as used above means a person not in the regular employment of the Contractor or having any vested interest in the Contractor's business

3. The Contractor's Land Surveyor is to provide the following:

A. (5) **Signed and Sealed** hard copies of final As-Built plans adhering to the following:

1. As-Built plans are to be in the same horizontal and vertical datum as the bid plans

2. As-Built plans are to be in the same scale as the bid plans

4. As-Built plans are to include the following:

1. Location of all Underground Utility, Drainage, Sewer Lines and Conduits
2. Floor Drain locations, top of grate and invert elevations
3. Dry Well locations and invert elevations
4. Catch Basin locations, top of rim and invert elevations
5. Trench Drain top of grate elevation
6. Top and bottom elevations on all stone retaining walls
7. Top of column elevations
8. Spot grades on concrete pads
9. Spot grades on centerline and edges of pavement
10. Percentage of slope arrows as show on Grading Plan **Sheet L3.10**
11. First floor elevations of the Bobcat and Porcupine Night Houses

1.02 AUTO CAD FILES

1. The contractors Land surveyor is to provide the OPRHP PIPC land surveyor with electronic AutoCAD As-Built files

A. AutoCAD As-Built files Model Space's north & east coordinate system and vertical datum to be the same as that of the bid plans existing conditions survey.

1.03 AS-BUILT POINT FILES

1. The contractors Land surveyor is to provide the OPRHP PIPC land surveyor with electronic AutoCAD As-Built point files in **.txt** file format in the following configuration:

A. Point Number, Northing, Easting, Elevation, Description

1.04 SUBMISSION OF AS-BUILT PLANS, AUTOCAD FILES & POINT FILES

A. At the completion of the project the contractor will deliver to the Director's Representative 5 hard copies of As-Built Plans

B. The contractors Land Surveyor will submit electronic As-Built AutoCAD files and Point files to: greg.askildsen@parks.ny.gov

Note: The Engineer of Record and the OPRHP PIPC Land Surveyor will provide the contractor's Land Surveyor with design AutoCAD files and horizontal & vertical field survey control base line points and point files prior to commencement of construction.

The Contractor's Land Surveyor is to validate the accuracy of said control points and report any discrepancy to the Director's Representative prior to preforming survey field work.

END OF SECTION

SECTION 017329

REMOVALS, CUTTING, AND PATCHING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

PROJECT CONDITIONS

A. Existing Conditions: Do not disturb areas immediately outside of construction areas unless noted under requirements of the Contract.

B. Refer to Drawing L0.03, Site Preparation Plan, for tree and misc. removals at the site.

C. Items to Remain the Property of the State: The following items shall remain the property of the State and shall be stored at the site where directed:

1. Existing large stones (both surface and sub-surface): remove/relocate and stockpile as directed by the Director’s Representative.

2. Any / all historical artifacts excavated or discovered during construction operations.

3. All Site Features and Signage not noted for Disposal.

PART 2 PRODUCTS

2.01 MATERIALS

A. Match the appearance and performance of existing corresponding materials as closely as practicable where applicable or noted on drawings, unless otherwise indicated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Prior to cutting, patching or removal of items not noted in the Contract Documents, the Contractor shall obtain instructions and approval from the Director’s Representative.

B. If unforeseen obstructions are encountered, take precautions necessary to prevent damage and obtain instructions from the Director's Representative before proceeding with the Work.

END OF SECTION

SECTION 033001

CAST-IN-PLACE CONCRETE - SITEWORK

PART 1 GENERAL

1.00 GENERAL PROVISIONS

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

1.01 WORK INCLUDED

A. Provide all equipment and materials and do all work necessary to construct the cast-in-place concrete, including but not limited to: formwork, reinforcing, and concrete for concrete retaining walls, curb walls, concrete footings, foundations, and below grade slabs, complete, as indicated on the Drawings and as specified.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that relate directly to work of this Section include, but are not limited to the following:

1. Section 033715, SPRAYED AND CARVED CONCRETE
2. Section 055001, METAL FABRICATIONS – SITEWORK
3. Section 055213 EXTERIOR METAL RAILS AND GAURDRAILS
4. Section 079200, EXTERIOR SEALANTS
5. Section 321313, PORTLAND CEMENT CONCRETE PAVING

1.03 RELATED WORK

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Concrete Institute (ACI):

308.1 Curing Concrete

309 Consolidation of Concrete

318 BuildingCode Requirements for Reinforced Concrete

325.9R Guide for Construction of Concrete Pavements and Concrete Bases

347 Concrete Formwork

2. American Plywood Association (APA):

Ref. 1 APA Design/Construction Guide, Residential and Commercial

3. American Society for Testing and Materials (ASTM):

A 36	Structural Steel
A 108	Steelbars, Carbon, Cold-Finished, Standard Quality
A 123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
A 143	Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
A 185	Welded Steel Wire Fabric for Concrete Reinforcement
A 307	Carbon Steel Externally Threaded Standard Fasteners
A 309	Weight and Composition of Coating on Terne Sheet by the Triple-Spot Test
A 386	Zinc Coating (Hot-Dip) on Assembled Steel Products
A 510	General Requirements for Wire Rods and Course Round Wire, Carbon Steel
A 569	Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality
A 615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
C 33	Concrete Aggregates
C 94	Ready-Mixed Concrete
C 143	Slump of Portland Cement Concrete
C 150	Portland Cement
C 171	Sheet Materials for Curing Concrete
C 494	Chemical Admixtures for Concrete
D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN- m/m^3))
D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
E 1745	Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs
D 1752	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

4. New York State Department of Transportation (NYSDOT):

Specifications	Standard Specifications

1.04 SUBMITTALS

A. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

B. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, supports for concrete reinforcement and connection to bedrock (as needed).

C. Formwork Shop Drawings: Show formwork construction including form-facing joints, rustications, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect exposed to view cast-in-place concrete.

D. Samples of the following shall be submitted:

Item	Sample Size
Preformed joint filler	Two pieces, full depth and width, 12 in. length
Form	12 in. x 12 in.
Form ties	1 each, complete

E. Submit manufacturer's product data for forms and accessories.

F. Field quality-control test and inspection reports.

G. Prior to start of concrete work, Contractor shall submit to the Director's Representative for review a schedule for execution of the work of this section and a location plan indicating sequence of concrete placement and location of proposed control joints and construction joints, if required.

1.05 DESIGN OF CONCRETE MIX

A. Mix design shall be certified by independent testing laboratory. Statement of materials constituting design of mixes (as required by referenced standards) shall be submitted for Director's Representative's approval within one week following award of Contract.

B. Concrete mix design shall include the following information:

1. Proportions of cement, fine and coarse aggregates, and water.
2. Water-cement ratio, design strength, slump, and air content.
3. Type of cement and aggregates.
4. Type and dosage of all admixtures.
5. Special requirements for pumping.
6. Range of ambient temperature and humidity for which the design is valid.
7. Any special characteristics of the mix which require precautions in the mixing, placing, finishing, or curing methods to achieve the finished product specified.

C. No concrete shall be delivered to the job site until the Director's Representative has approved the design mixes.

1.06 QUALITY ASSURANCE

A. Unless otherwise specified, cast-in-place concrete work shall conform to ACI 301.

B. Construction of concrete walks and subbases shall conform to ACI 325.9R

C. Dimensions, locations and details of equipment pads, anchors, supports, and similar features indicated on the Drawings are approximate. Manufacturer's approved shop drawings of equipment to be supported, anchored, or contained thereby shall be consulted for exact location, size, and details.

D. Proposed wall footings shall be laid out and staked for review and approval by Director's Representative prior to pouring concrete.

E. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

F. Pre-installation Conference: Conduct conference at Project site.

1.07 QUALITY CONTROL

A. Unless otherwise specified herein, or indicated on the Drawings, concrete formwork construction and materials shall conform to ACI 301, 318, and 347, and the following:

1.	Variation from plumb		
	a.	In lines and surfaces of arrises:	
		In any 10 ft. of length	¼ in.
		Maximum for the entire length	1 in.
	b.	For exposed conspicuous lines:	
		In any 20 ft. of length	¼ in.
		Maximum for the entire length	½ in.
2.	Variation in sizes and location of sleeves, wall openings:		¼ in. (+/-)
3.	Variation in cross sectional dimensions of beams and in thickness of slabs:		Minus ¼ in. Plus ½ in.
4.	Variation in location of anchor bolts unless provided with sleeves or other means of adjustment:		Minus ¼ in.

B. Maximum deflection of form facing materials at concrete surfaces exposed to view shall be 1/240 of span between structural members.

C. Reinforcing steel shall be fabricated to conform to the required shapes, dimensions, and tolerances specified in CRSI Manual.

D. Allowable Tolerances:

1. Fabricating:

a.	Sheared length:	Plus or minus 1 in.
b.	Stirrups and ties:	Plus or minus 1/2 in.
c.	Members more than 8 in., but not over 2 ft. - 0 in. deep:	Plus or minus 1/2 in.
d.	Members more than 2 ft. - 0 in. deep:	Plus or minus 1 in.

e. Crosswise of members: Space evenly within 2 in. of stated separation

f. Lengthwise of members: Plus or minus 2 in.

2. Maximum bar relocation to avoid interference with other reinforcing steel, conduits, or other embedded item: 1 bar diameter.

1.08 TESTING

A. Inspection and testing of the concrete mix will be performed by an independent testing laboratory approved by the Director's Representative. Testing equipment shall be supplied by the laboratory, and the preparation of samples and all testing shall be performed by the laboratory personnel.

B. Concrete materials and operations will be tested and inspected as work progresses.

Failure to detect any defective work or material shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Director's Representative to final acceptance.

C. The following testing services shall be provided by the Owner, at no cost to the Contractor:

1. Review and test of the Contractor's proposed materials for compliance with the specifications.
2. Review of the Contractor's proposed mix design.
3. Sampling and testing of materials at plants or stockpiles during the course of the work for compliance with the specifications.
4. Strength tests of concrete specimens.
5. Inspection of concrete batching, mixing, and delivery.

D. The following testing services shall be provided at the Contractor's expense:

1. Additional testing and inspection required because of changes in materials or proportions requested by the Contractor.
2. Additional testing of materials or concrete occasioned by their failure by testing or inspection to meet specification requirements.

E. At least four standard compression test cylinders shall be made and tested from each day's placement of concrete. Four concrete test cylinders will be taken for every 50 cubic yards of each type and design strength of concrete placed. Two cylinders shall be tested at seven days, and two at 28 days. One additional test cylinder will be taken during cold weather concreting and will be cured at the job site under the same conditions as the concrete it represents. If job experience indicates additional cylinder tests or other tests are required for proper control or determination of concrete quality, such tests shall be made.

F. One slump test will be taken for each set of test cylinders taken.

G. Submit to the Owner, for forwarding to the testing laboratory, proposed concrete mix design for review, before beginning work.

H. Provide free access to work and full assistance and cooperation, concrete for samples, and such auxiliary personnel and equipment as needed for testing agency to take samples for required tests. Notify testing agency and Director's Representative of intent to place concrete at least 24 hours before placement.

PART 2 PRODUCTS

2.01 FORM MATERIALS AND ACCESSORIES

A. Concrete surfaces which will be visible after completion of the structure, painted or unpainted, shall be formed to have a "smooth-form" finish, as defined by ACI 301. The form facing materials shall produce a smooth, hard, uniform texture on the concrete.

1. Form material shall be plywood, tempered concrete-formgrade hardboard, or metal, capable of producing the required finish.
2. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
3. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
4. Other form materials shall not be used without prior written permission of the Director's Representative.

B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with smooth form finish. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

1. Forms shall not impart visible straight or spiral mark on concrete columns.

C. Concrete surfaces which will be concealed in completed structure shall be formed to have a "rough form" finish as defined by ACI 301.

D. Forms shall be true to line and free from warp, and shall be of sufficient strength, when braced, to resist the pressure of the concrete during placement within the allowable tolerances.

E. Surfaces of forms to be in contact with concrete shall be coated with nonstaining form release compound similar to Tamms Luster Seal; wetting or coating with grease or oil will not be accepted as a substitute. Approval of the Director's Representative shall be obtained before coated (plastic-faced) form material or liners are used in lieu of form release compound.

F. Unless otherwise indicated on the Drawings, exposed corners of beams, columns and walls and other concrete arises shall be chamfered. Where other dimension is not indicated on the Drawings, chamfer shall be 3/4 x 1/2 in.

1. Chamfer shall not be employed where masonry or other material will subsequently be installed flush with one of the adjacent surfaces of the concrete.
2. Where a wash or slope is indicated on the Drawings, no additional chamfer is required.
3. Chamfer shall be mitered at changes in direction.

2.02 FORM ACCESSORIES

A. Form ties shall be factory-fabricated metal ties, shall be of the removable or internal disconnecting or snap-off type, and shall be of a design that will not permit form deflection and will not spall concrete upon removal. Solid backing shall be provided for each tie. Except where removable tie rods are used, ties shall not leave holes in the concrete surface less than 1/4 inch nor more than 1 inch deep and not more than 1 inch in diameter. Removable tie rods shall be not more than 1-1/2 inches in diameter.

B. Where steel adjacent to vertical faces of forms cannot be otherwise secured, mortared doughnuts shall be used to prevent steel lying too close to finish vertical faces of the concrete.

C. Forms at doweled joints shall have accurately sized and located holes for dowels. Split forms may be used to facilitate stripping.

D. Reglets shall be made of polyvinyl chloride, grey color. Where reglets are indicated on the drawings they shall be assumed to be continuous. Reglets shall be filled with a disposable packing material to prevent entrance of concrete.

E. Form Release Agent: Form releasing agents shall be commercial formulations that will not bond with, stain or adversely affect concrete surfaces. Agents shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds.

F. Construction Joint Form: Burke Concrete Products, "Keyed Kold Joint", or approved equal.

2.03 STEEL BARS AND SUPPORTS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 60 percent.

B. Steel reinforcing bars shall conform to ASTM A 615/A 615M, Grade 60, deformed, including Supplementary Requirements S1.

1. Bars employed as reinforcement and dowels shall be deformed type.
   a. Cutting of bars by torch will not be permitted.
2. Bars employed as dowels, spirals, and structural ties or supports shall be hot-rolled plain rounds.
   a. Plastic-coated dowels, such as Doubl-Coat plastic-coated steel dowel bars, manufactured by Republic Steel Corporation, or approved equal, are acceptable.
3. Bars employed in joints subject to movement shall be hot-rolled plain rounds.
   a. Bars for use in joints subject to movement shall be saw-cut. Bars crimped or bent

C. Reinforcing bars shall be manufactured in the United States.

D. Epoxy-Coated Wire: ASTM A 884/A 884M, Class A, Type 1 coated-steel wire, with less than 2 percent damaged coating in each 12-inch (300-mm) wire length.

E. Plain-Steel Welded Wire Reinforcement: ASTM A 185, plain, fabricated from as-drawn steel wire into flat sheets. Fabric reinforcement shall be furnished in flat sheets; reinforcement furnished in rolls will not be acceptable.

F. Steel failing to meet the requirements of this specification or the Drawings will be rejected and shall be removed from the site immediately. Rejected steel shall be replaced with new steel conforming to this specification, at no additional cost to the Owner.

G. Bolsters, chairs, supports, and other devices for spacing, supporting, and fastening of reinforcing in place shall conform to requirements of CRSI Manual.

H. Tie wire shall be black annealed wire, 16 gauge or heavier.

2.04 AGGREGATE BASE COURSE

A. Material for aggregate base course shall be a graded, granular, free-draining material, consisting of crushed aggregate, practically free from loam and clay, and which can be readily compacted to form a stable foundation.

2.05 CONCRETE

A. Concrete shall be air-entrained type, conforming to ASTM C 94. Air-Entraining Admixture: ASTM C 260.

B. Unless otherwise indicated on the Drawings, minimum 28-day compressive strength shall be 4,000 psi.

1. Concrete slump shall be no less than 2 in. nor greater than 4 in., determined in accordance with ASTM C 143.
2. Maximum Water-Cementitious Materials Ratio: 0.45.
3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch (19- mm) nominal maximum aggregate size.

C. Cement shall be Portland cement, conforming to ASTM C 150, Type I or II.

D. Aggregates shall conform to ASTM C 33.

E. Concrete shall contain a water reducing agent to minimize cement and water content of the concrete mix at the specified slump. Water reducing agent shall conform to ASTM C 494.

F. No calcium chloride or admixtures containing calcium chloride shall be added to the concrete. No admixtures other than those specified shall be used in the concrete without the specific written permission of the Director's Representative in each case.

2.06 CURING MATERIALS

A. Curing shall be by moist curing or by use of curing compound.

B. Curing paper shall be a nonstaining, fiber reinforced laminated kraft bituminous product conforming to ASTM C 171. Four mil polyethylene sheeting may be substituted for curing paper.

C. Liquid membrane forming curing compounds will not be permitted.

D. Curing compound shall be a resin-base, white pigmented compound conforming to ASTM C 309, Type 2.

2.07 EXPANSION JOINTS

A. Unless otherwise indicated on the Drawings, wall and foundation expansion joints shall be located 30 ft. o.c., maximum.

B. Below grade base slab joints shall be located as indicated on the Drawings.

C. Where indicated, wall expansion joints shall be 3/8 in. wide, and recessed ½ in. from face of wall. Expansion joint filler shall be preformed, nonbituminous type joint filler conforming to ASTM D 1752, Type II, similar to Sealtight Cork Expansion Joint Filler, manufactured by W.R. Meadows, Inc., or approved equal.

1. Premolded filler shall be one piece for the full depth and width of the joint.
2. Use of multiple pieces of lesser dimensions to make up required depth and width of joint will not be permitted.
3. Except as otherwise noted on the Drawings, joint filler shall be 3/8 in. thick.

D. Where indicated, concrete slab-on-grade shall be doweled at each expansion joint. One end of the dowel shall be greased.

E. Round Expansion Joint Dowels: ASTM A615, Grade 60, epoxy-coated, smooth, billet-steel bars, clean and free of rust and scale.

F. Square Expansion Joint Dowels: ASTM A108, epoxy-coated, alloy-steel square bar.

G. Sleeves for Square Dowels: Sika Greenstreak square dowel sleeves and bases sized to fit epoxy-coated square dowels.

H. Dowel Caps for Round Dowels: Plastic caps approximately 4" long, designed and manufactured to fit over ends of expansion joint dowels to allow longitudinal movement of dowels after concrete has hardened.

I. Dowel Aligners for Round Dowels: PNA Dowel Aligners or approved equal.

2.08 WATERSTOPS

A. Waterstops shall be virgin polyvinyl chloride and shall not contain any scrap or reprocessed materials. Waterstop shall meet or exceed the requirements of the COE CRD-C 572 and the following:

1. PVC compound shall have a minimum tensile strength of 2,000 psi and shall have an elongation at break of not less than 300%.
2. Waterstop manufacturer shall submit a copy of certified laboratory test data indicating compliance with the referenced specification.
3. Waterstops shall be furnished in the longest practicable lengths.
4. Waterstop, except expansion joint waterstop, shall be ribbed type.
5. Expansion joint waterstop shall be ribbed type with center bulb.
6. Corner intersections, and intersection of vertical and horizontal waterstops shall be factory spliced or factory-made.

B. Do not bend waterstops within forms. Do not use split waterstops.

2.09 CONTROL JOINTS

A. Control joints indicated to be sawn shall be made by saw cutting concrete slab after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw blade shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

B. Unless otherwise indicated on the Drawings, control joints shall be located 10 ft. o.c. maximum.

2.10 BOLTS AND ANCHORING SYSTEMS

A. Anchor bolts and anchoring systems shall be furnished under Section 055001, METAL FABRICATIONS – SITEWORK for installation under work of this Section.

PART 3 EXECUTION

3.01 GRADING

A. Areas to be paved will be compacted and brought approximately to subgrade elevation under earthwork operations performed under separate contract with the Owner before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving, as required to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.

B. Existing subgrade material which will not readily compact as required shall be removed and replaced with satisfactory materials. Additional materials needed to bring subgrade to required line and grade and to replace unsuitable material removed shall be material conforming to this Section.

C. Subgrade of areas to be paved shall be recompacted as required to bring top 8 in. of material immediately below gravel base course to a compaction of at least 90% of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of at least 1 ft. beyond pavement edge.

D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade or subbase subsequent backfill and compaction shall be performed as directed by the Director's Representative. Completed subgrade after filling such areas shall be uniformly and properly graded.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 2 in. deep in subgrade, shall be graded out, reshaped as required, and recompacted before placing pavement.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall conform to the following:

1. Material shall be legally disposed of off-site.

H. Prepared subgrade will be inspected by the Director's Representative. Subgrade shall be approved by the Director's Representative before installation of paving base course. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section of the specification.

3.02 AGGREGATE BASE COURSE

A. Graded aggregate base course for paving and the spreading, grading, and compaction methods employed shall conform to standard requirements for usual base course of this type for first class road work, and the following:

B. Compaction of dense graded crushed stone course shall be to 95% of maximum density as determined by ASTM D 1557, Method D. Stone greater than 2-1/2 in. shall be excluded from course.

C. Width of base course shall be greater than or equal to the width of pavement surface, if continuous lateral support is provided during rolling, and shall extend at least 2 x base thickness beyond edge of the course above, if not so supported.

D. Aggregate material shall be applied in lifts less than or equal to 3 in. thick, compacted measure. Each lift shall be separately compacted to specified density, using a 6-ton steel wheel roller or vibratory roller equivalent to a 6-ton static roller, or an approved equivalent.

1. Material shall be placed adjacent to wall, manhole, catch basin, and other structures only after they have been set to required grade and level.
2. Rolling shall begin at sides and progress to center of crowned areas and shall begin on low side and progress toward high side of sloped areas. Rolling shall continue until material does not creep or wave ahead of roller wheels.
3. Surface irregularities which exceed 1/2 in. measured by means of a 10 ft. long straightedge shall be replaced and properly compacted.

E. Subgrade and base course shall be kept clean and uncontaminated. Less select materials shall not be permitted to become mixed with gravel. Materials spilled outside pavement lines shall be removed and area repaired.

F. Portions of subgrade or of construction above which become contaminated, softened, or dislodged by passing of traffic, or otherwise damaged, shall be cleaned, replaced, and otherwise repaired to conform to the requirements of this specification before proceeding with next operation.

3.03 ACCEPTABILITY OF CONCRETE SURFACES

A. Concrete structures to receive concrete topping slab shall be inspected to ensure that surface is suitable to receive concrete. Waterproofed surfaces shall be thoroughly cured and suitably protected with protection board prior to start of concrete work of this section.

3.04 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

1. Curved walls shall be shaped to produce a smooth, continuous line free from tangents in accordance with shape(s) indicated on the Drawings.

C. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-formed finished surfaces.
2. Class C, 1/2 inch (13 mm) for rough-formed finished surfaces.

D. Forms shall be sufficiently tight to prevent leakage of mortar, and, where necessary, shall have temporary openings as required for thorough cleaning and as required for the introduction of concrete to avoid excessive free fall.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.05 PLACING OF REINFORCING

A. Reinforcing bars shall be placed in accordance with ACI 301, 318, and CRSI "Manual of Standard Practice". Reinforcing bars showing cracks after bending shall be discarded and replaced with new material conforming to this Section at no additional cost to the Owner.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Reinforcing shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material which may reduce the bond between concrete and reinforcing. Where there is a delay in placing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

C. Unless permitted by the Director’s Representative, reinforcing bars shall not be cut in the field.

D. Clear concrete cover for reinforcing steel shall comply with the following:

Walls:	2 in. exterior faces
Slab on Grade:	¾ in. top steel

	1-1/2 in. bottom steel
Footings:	2 in. formed edges
	3 in. cast against ground

E. After forms have been coated with form release compound, but before concrete is placed, reinforcing steel shall be securely wired in exact position called for, and shall be maintained in that position until concrete is placed and compacted. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Director's Representative.
2. Metal supports shall be the types which will not penetrate and show through or stain surfaces which are to be exposed to view, painted or unpainted. Supports at surfaces which will be exposed to the weather shall be stainless steel, plastic tipped, or other non-corrosive material.
3. Where steel is adjacent to vertical form face and cannot be otherwise secured, mortar doughnuts shall be used to prevent steel from lying too close to finished vertical concrete face.
4. Where waterproofed surfaces are indicated, reinforcing bar chairs, bolsters, and other supports shall not rest on waterproofing membrane. To protect membrane from puncture, chairs, bolsters, etc., shall rest on 1/4 in. thick hardboard, which shall be centered under the support leg. Area of hardboard shall not be less than 3 sq. in. per leg.

F. Except as otherwise noted, laps at joints in welded wire fabric reinforcement shall be at least 6 in. and shall be securely tied with tie wire.

G. Except as otherwise specified, reinforcing steel shall be spliced by lapping bar ends, placing bars in contact, and tightly wiring. Minimum lap of spliced bars shall conform to ACI 318, Class B.

1. Bars No. 14 and larger shall not be lap spliced.

H. Doweled Joints

1. Dowels at expansion joints and at other locations where movement of the joint is expected shall be thoroughly clean on the embedded portion to permit good bond and shall be greased or otherwise treated to prevent bond for the full length of the portion which is intended to move in the concrete.
2. Factory plastic-coated dowels where approved for use need not be lubricated, and the plastic coating need not be removed from any part of the dowel.
3. Dowels in concrete which are placed in locations or under temperature conditions which may be expected to cause movement of the concrete toward the joint, at any time during the life of the structure, shall have a cap on the lubricated end (either end of a factory plastic-coated dowel). Cap shall provide a 2 in. long air space into which dowel may move when concrete expands toward joint. Cap shall be properly secured to the end of the dowel, to prevent cap being dislodged during concrete placing operations, but to permit dowel to slide into the air space when concrete expands.

I. Bending: Bend bars cold; do not use heat reinforcing or bend by make-shift methods. Discard bent, kinked or otherwise damaged bars.

J. Welding of reinforcing bars will be permitted only where permission of the Director's Representative has been obtained in advance. Such welding shall be performed only under conditions established by the Director's Representative.

1. Weld reinforcing bars according to AWS D1.4, where indicated.

K. Unless otherwise indicated on the Drawings, reinforcing shall extend within 2 in. of formwork and expansion joints. Reinforcement shall continue through construction joints.

L. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

M. Longitudinal reinforcing steel in bond beams, walls and footings shall be continuous around corners.

3.06 WATERSTOP

A. Unless otherwise indicated on the Drawings, waterstop shall be centered over expansion joint and securely held in place during concrete placement to prevent misalignment.

B. Waterstop sections shall be butt spliced using a heat sealing method in accordance with the manufacturer's directions. Waterstop shall not be joined by lapping.

C. Special fittings at intersections shall be installed in accordance with the waterstop manufacturer's recommendations.

3.07 PLACING CONCRETE

A. Before placing concrete, forms and space to be occupied by concrete shall be thoroughly cleaned and reinforcing steel and embedded metal shall be free from dirt, oil, mill scale, loose rust, paint, and other material which might tend to reduce bond.

B. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall be thoroughly damp when concrete is placed. There shall be no free water on surface.

C. Concrete which has set or partially set before placing shall not be employed. Retempering of concrete will not be permitted.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 309.
2. If concrete cannot be mechanically consolidated, concrete shall be thoroughly spaded and tamped to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.

E. Cold-Weather Placement: Comply with ACI 306.1. F. Hot-Weather Placement: Comply with ACI 301.

F. When joining fresh concrete to concrete which has attained full set, latter shall be cleaned of foreign matter, and mortar scum and laitance shall be removed by chipping and washing. Clean, roughened base surface shall be saturated with water, but shall have no free water on surface. A coat of 1:1 cement-sand grout, approximately 1/8 in. thick, shall be well scrubbed into thoroughly dampened concrete base. New concrete shall be placed immediately, before grout has dried or set.

3.08 FINISHING

A. General:

1. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Remove fins and other projections exceeding specified limits on formed-surface irregularities. Repair and patch tie holes and defects.
2. Rubbed Finish: Apply the following to smooth-form-finished as-cast concrete where indicated:
    a. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

B. Below grade concrete slabs and pads shall be screeded off and finished true to line and grade, and free of hollows and bumps. Surface shall be dense, smooth, and at exact level and slope required.

1. Finished concrete surface for subbases shall be wood-floated to a slightly rough surface. Surface shall not deviate more than 1/4 in. in 10 ft.

C. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

3.09 FINISHING BELOW GRADE SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

1. Concrete slabs and pads shall be screeded off and finished true to line and grade, and free of hollows and bumps. Surface shall be dense, smooth, and at exact level and slope required.
2. Finished concrete surface for subbases shall be wood-floated to a slightly rough surface. Surface shall not deviate more than 1/4 in. in 10 ft.

B. Control joints shall be scored into slab surface with scoring tool.

C. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

3.10 PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. It is essential that concrete be kept continuously damp from time of placement until end of specified curing period. It is equally essential that water not be added to surface during floating and troweling operations, and not earlier than 24 hours after concrete placement. Between finishing operations surface shall be protected from rapid drying by a covering of waterproofing paper. Surface shall be damp when the covering is placed over it and shall be kept damp by means of a fog spray of water, applied as often as necessary to prevent drying, but not sooner than 24 hours after placing concrete. None of the water so applied shall be troweled or floated into surface.

C. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.11 EXPANSION JOINTS

A. Expansion joint shall be 3/8 in. wide, clean, dry, and free of loose material, dirt, oil and grease, and shall be formed in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full length of the expansion joint.

1. Depth of filler shall extend to the full thickness of the concrete in vertical surfaces and in concealed horizontal surfaces.
2. Depth of filler in exposed horizontal surfaces shall be as required to form a 1/2 in. deep sealant recess below finished surface to depth recommended by sealant manufacture.

3.12 EXPANSION JOINT DOWELS:

A. Center vertically in slab, unless indicated otherwise.

B. Center longitudinal position of each dowel horizontally on joint, except where indicated otherwise.

C. Install at same spacing as slab bar unless indicated on Drawings.

D. Install a cap or sleeve on one end of each dowel as indicated on Drawings.

E. Prior to installing the cap or sleeve on the dowels, completely coat surfaces of each dowel on the cap-side or sleeve-side of the expansion joint with debonding compound.

F. Cut holes in expansion joint fill material accurately to fit tightly around dowels so that concrete will not leak into gaps between the dowels and the expansion joint material.

G. Install dowels 90 degrees horizontally and vertically to expansion joint using dowel aligners to help maintain alignment.

H. Install the dowel aligners in accordance with the manufacturer's current printed instructions.

3.13 CONTROL JOINTS

A. Joints shall be sawn as soon as the concrete will withstand the energy of sawing without raveling or dislodging aggregate particles. For most concrete mixtures, this means sawing should be completed within the first 6 to 18 hours and never delay more than 24 hours. Early-entry saws may be used to allow cutting to begin within a few hours after placement.

B. Control joints indicated shall be sawn 1/8 in. wide by using a diamond blade concrete power saw. Saw shall cut into slab at least 25% of slab depth. Saw cut joints shall be straight and accurate to line.

1. Saw cut joints shall be sawn flush to vertical surfaces.
2. Unless otherwise indicated on the Drawings, control joints in pedestrian pavements shall be located 10 ft. o.c. maximum.
3. Doweled Control Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.14 REMOVING FORMS AND SUPPORTS

A. Forms shall be removed preventing injury to the concrete and ensuring the complete safety of the structure. Formwork for parts not supporting the weight of concrete may be removed when the concrete has attained sufficient strength to resist damage from the removal operation but not before at least 24 hours has elapsed since concrete placement. Supporting forms and shores shall not be removed from beams, floors and walls until the structural units are strong enough to carry their own weight and any other construction or natural loads. Supporting forms or shores shall not be removed before the concrete strength has reached 70 percent of design strength, as determined by field cured cylinders or other approved methods. This strength shall be demonstrated by job-cured test specimens, and by a structural analysis considering the proposed loads in relation to these test strengths and the strength of forming and shoring system. The job-cured test specimens for form removal purposes shall be provided in numbers as directed and shall be in addition to those required for concrete quality control. The specimens shall be removed from molds at the age of 24 hours and shall receive, insofar as possible, the same curing and protection as the structures they represent.

B. Panels damaged in stripping or otherwise shall not be reused.

C. Forms to be reused on the work shall be thoroughly cleaned immediately after stripping. Damaged forms shall not be used. Only clean, sound, dimensionally correct forms shall be used.

3.15 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Director’s Representative. Remove and replace concrete that cannot be repaired and patched to Director’s Representative's approval.

END OF SECTION

SECTION 033715

SPRAYED AND CARVED CONCRETE (ARTIFICIAL ROCKWORK)

PART 1 GENERAL

1.01 GENERAL PROVISIONS

A. Attention is directed to the CONTRACT AND GENERAL CONDITIONS and all Sections within DIVISION 01- GENERAL REQUIREMENTS which are hereby made a part of this Section of the Specifications.

1.02 WORK INCLUDED

A. Work in this section shall include all labor, artistry, materials, and equipment required to establish structural and finish fabrication of the following features as indicated on the drawings:

1. Artificial Rockwork (emulations of distinct geologies).
2. Natural rock including boulders, cobble, and river stone.
3. Painting to simulate natural effects within rockwork including minerals, intrusions, lichens, and mosses.
4. Waterproofing of all areas that are consistently exposed to water.
5. Coordinate with the General Contractor and other trades in the installation of utilities inside rockwork including installing sleeves for drains, irrigation, and special effects such as audio elements.

1.03 RELATED DOCUMENTS

A. Examine Contract Documents for requirements that affect work of this Section. Other specification Section that directly relate to work of this Section include, but are not limited to:

Section 055213 – Exterior Metal Rails and Guardrails
Section 329119 – Landscape Grading

1.04 SUBMITTALS

A. Shop drawings including but not limited to the following:

1. Rockwork formations requiring special attention.
2. Sleeving diagram showing size and location of all sleeves required.
3. Control and expansion joint locations.
4. All shop drawings that propose an alternative or change from the design shown in the drawings shall be stamped by a structural engineer licensed in Massachusetts.

B. Samples: Contractor shall provide on-site samples of each of the items listed:

1. Artificial Geologies: Minimum 6’x6’ for each geology listed below, the panel shall be fully finished including painting by lead artist retained and guaranteed for the project:
   a. Granite (igneous)

2. Natural boulders cobble and pebbles.
3. Waterproofing membrane material.
4. Product data: Provide data regarding tested durability and non-toxicity of samples.

C. Painting reference material including color photographs and sketches by the proposed artist.

D. Resumes with precise description of role in each project and name of superintendent for project; references, letters of recommendation, and designated responsibilities for each crew member/artist assigned to the job. Supply a signed letter of commitment to the project from each.

1.05 QUALITY CONTROL

A. Design, test and adjust concrete mixes before first concrete is scheduled to be placed.

B. The Contractor shall engage the services of a Testing Laboratory for the following:

1. Review of concrete mix designs, certificates of compliance, and samples of materials.
2. Perform compression tests during the progress of work consisting of not less than three (3) identical test specimens for standard cylinder tests at the jobsite for each 100 cubic yards or less of each class of concrete placed per day.

C. The following standards by the American Society for Testing and Materials (ASTM).

A615	Specification for Deformed and Plain Billet Steel Bars.
C31	Making and Curing Concrete Test Specimens in the Field.
C172	Sampling Fresh Concrete.
Dl 785	Polyvinyl Chloride (PVC) Schedule 40 pipe.
D2466	Socket-Type Polyvinyl Chloride (PVC) Schedule 40 Pipe Fittings
AS3	Structural Steel Pipe, Grade B.

1.06 QUALITY ASSURANCE

A. The Contractor for the artificial rockwork shall be an established firm with the following minimum level of experience:

1. Seven (7) years' experience in successfully constructing simulated formations for theme parks and resorts.
2. Seven (7) years' experience in carved application techniques.
3. Minimum one Lead Artist with seven (7) years' experience constructing simulated natural formations preferably with a degree in Fine or Applied Art and life experience with the environments proposed for emulation. Experience reading plans and good communication skills.
4. Site Superintendent with seven (7) years' experience in fabrication application techniques and experience in coordinating with other trades in the completion of artificial rockwork fabrication projects.
5. Project Manager with seven (7) years' experience in fabrication application techniques and experience in coordinating with other trades in the completion of artificial rockwork fabrication projects.

6. List of completed projects for each listed above including client contact information and photos of actual work carved by artists) or overseen (superintendent, project manager) shall be provided for acceptance of qualifications.

B. Codes and Standards: Perform all work in compliance with applicable requirements of governing authorities having jurisdiction.

C. Equipment: Machinery and tools necessary for the prompt, professional completion of the work.

D. Shelter: All work shall be sturdily sheltered as required without cramping the work environment so that weather cannot delay production.

1.07 DESIGN CRITERIA AND DEFINITIONS

A. The fabrication of the artificial rockwork shall be accomplished in such a manner as to appear as realistic as possible. Care must be taken to ensure that the dramatic, yet natural quality of the design be maintained.

B. The fabrication and installation of artificial rockwork is artistic in nature and may require adjustments, reconstruction, and/or demolition of completed work to obtain the desired effect. Minor changes, corrections and/or adjustments to artificial rockwork in place shall be made at no increase in the Cost of the Work.

C. All final aesthetic judgments shall be those of the Architect. All design criteria shall be signed-off by the Architect.

D. Artificial Rockwork Definition: Emulations of distinct geologies.

1. Carved and/or embossed shotcrete: Premium fine aggregate and cement and water pneumatically pumped and blown using compressed air onto armatures.
2. Carved and/or embossed plaster: Site-mixed very fine aggregate and cement mixed with water, then pumped and blown using compressed air onto previously rough-formed shotcrete. Skilled artists interpret the requirements of the environments as specified by the designers by carving by hand the concrete as it dries.
3. Painting: Painting on three-dimensional features. The use of approved paints and skilled artists to render the effects of minerals, intrusions, organic growth and of natural aging upon the environment.

E. General contours and profiles of artificial rockwork as indicated on the drawings shall be followed in order to accomplish design in each area.

1.08 DELIVERY AND STORAGE

A. Deliver products in manufacturer’s unopened containers, fully identified.

B. Protect from weather, soiling and damage as recommended by the manufacturer.

C. Keep all concreting and plastering materials dry until used. Keep materials off the ground, under cover, and clear of damp walls or other damp surfaces.

1.09 SCAFFOLDING, PROTECTION, AND CLEAN-UP

A. Provide, install and maintain for the duration of this work, scaffolding, trestles and planking necessary for the work of this Section.

B. Protection of project materials, including waterproofing that is susceptible to damage during forming, placing or reinforcement of shotcrete or equivalent.

C. Coordinate with others to protect or remove damageable materials of others before beginning work.

D. Clean up rebound from shotcrete or equivalent operations immediately and dispose of as void or structural fill. Do not allow rebound to be integrated into concrete.

E. Do not leave or bury loose pieces of reinforcing, sheet or expanded metal, tie wire, plastics or any other material not fully-embedded in concrete.

F. Clean overspray and rebound from adjacent materials immediately.

G. All wet spills shall be cleaned up immediately using efficient and appropriate means.

H. Provide safe health and safety conditions including, but not limited to, the use of adequate respirators, ventilation and light in all work areas where deemed appropriate.

PART 2 PRODUCTS

2.01 SHOTCRETE PRODUCTS AND ACCESSORIES

A. Shotcrete: Pneumatically placed wet mixture of aggregate and Portland cement. Strength shall be 5800 psi minimum silica fume wet mix in 28 days for footings, slabs, and structure coat (‘shells’.)

B. Cement Plaster (‘Texture Coat’): Pneumatically placed wet mixture of sand and Portland cement with a minimum compressive strength of 4000 psi, in 28 days.

C. Pencil Rod and other reinforcing bars: 40 ksi mild reinforcing.

D. Lathing Materials (dry): galvanized heavy-duty diamond lathe.

E. Lathing Materials (wet): plastic or other non-rusting, non-toxic lath, with resin coated 150 x 150 mm reinforcing mesh for pool bottoms.

F. Wire: 16-gauge soft-annealed coated tie wire or other non-rusting, non-toxic wire.

G. Mechanical Anchoring System: Hilti HSL-3 Heavy Duty Expansion Anchor 3.3.2 by Hilti, Inc. or equal.

H. Adhesive Anchoring System: Hilti HIT-HY 200 by Hilti, Inc. (USA) 1-800-879-8000, www.hilti.com or equal

I. Concrete Accelerator: Shotset 250 Liquid Accelerator available from: Shotcrete Technologies, Inc. 1431 Miner Street, Idaho Springs, CO 80452, 303-567-4871 or Owner approved equal.

J. Water.

K. Fly Ash: ASTM C-618, Type C or Type F.

L. Exhibit Accessory Fasteners.

M. Expansion joint filler board, ½" thick.

N. Paint: Non-fading, non-toxic, water and medium-thinned artist acrylic-vinyl. Golden Fluid Acrylics by Golden Artist Colors Inc. 188 Bell Road, New Berlin, NY 13411, 800-959-6543, www.goldenpaints.com or Owner approved equal.

O. Paint Thinning Medium: Acrylic Thinning Medium by Golden Artist Colors Inc. 188 Bell Road, New Berlin, NY 13411, 800-959-6543, www.goldenpaints.com or Owner approved equal.

2.02 NATURAL FINISH MATERIALS:

A. Boulders, cobbles and river stone securely placed by anchor, glue, concrete, or other approved method on both artificial rockwork, finish grade and planter areas shall be of same range and variation as the artificial rockwork including any appropriate encrustations when possible.

B. Boulders shall be unscarred and of the sizes required by drawings. Refer to Section 323260 Natural Boulders for source.

C. Cobble sizes shall range between 1" and 12"

D. River Stone shall consist of sound, durable, washed particles primarily occurring in conjunction with cobble.

2.03 WATERPROOFING PRODUCTS:

A. Crystalline capillary waterproofing, where noted on the drawings, for application to formations where contact with water requires waterproofing shall be Xypex Admix C-1000 from Xypex Chemical Corporation, 13731 Mayfield Place, Richmond, B.C. Canada V6V 2G9, Tel: 604 273-5265, Tel: 1-800-961-4477, Fax: 604 270-0451, www.xypex.com or Owner approved equal.

B. Flexible, cementitious, protective and waterproof coating where noted on the drawings shall be 'Aquafin 2k/m' available through Aquafin, Inc. 505 Blue Ball Rd, #160, Elkton, MD 21921, Tel. 410-392-2300, www.aquafin.net

C. Hydrophilic Waterstop: Adeka Ultra Seal MC-2010MN Preformed Rubber Waterstops by Adeka Corporation Tokyo, Japan imported by OCM, Inc. Chicago, IL, 800-999-3959, www.adeka.com, as indicated on the drawings or Owner approved equal.

2.04 OTHER PRODUCTS:

A. Polyvinyl Chloride (PVC) Irrigation and Mechanical Pipe Type 1120-1220, ASTM D 1785 and fittings Type 1, ASTM D 2466.

1. All pipes shall by furnished by others and installed by the Contractor for the artificial rockwork except where noted otherwise on the drawings.

B. Drainage Composite: shall be CCW Miradrain 6000 by Carlisle Coatings and Water proofing, www.carlisleccw.com, 900 Hensley Lane, Wylie, TX. 75098, 1-800-527-7092.

PART 3 EXECUTION

3.01 INSPECTION

A. Verify that all surfaces to receive artificial rockwork are satisfactory for the installation.

3.02 PRECAUTIONS

A. No cold-sensitive work shall be performed when the outside temperature is 56 degrees Fahrenheit or below unless written permission is obtained from the Owner or adequate, safe heated protective structures have been built prior to occupation and approved by Owner.

B. No wet sensitive weather work shall be performed unless the work area is covered and protected by an Owner approved protective structure.

C. Protect surrounding surfaces from overspray, staining, etc.

D. Repair all damage to building structure, surfaces, and finishes caused by the installation of the artificial rockwork.

3.03 PROVISIONS FOR OTHER TRADES

A. The Contractor shall be responsible for coordination of all other trades and Owner supplied items to fully complete the artificial rockwork with no delay to work schedule.

B. Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, drains, vents, weep holes, recesses, and chases from trades providing such items. All non-sleeved piping shall be set by the appropriate contractor except that sleeves shall be provided by the appropriate contractor and installed by the Rockwork contractor. Accurately place and securely support items built into forms.

3.04 FORMING SHOTCRETE AND CAST STRUCTURES

A. Coordinate with General Contractor on footing installation by others.

B. Install steel reinforcing grid work or equivalent required for walls, formed to shapes and profiles as indicated on the drawings. Lap reinforcing bars at splices a distance equal to 36 diameters of the bars.

C. Install steel reinforcing armature as per the drawings.

D. Install lath, pencil rod, and other related items required for rockwork wall armatures.

E. Install PVC plastic drain pipe, in sizes appropriate to the size of the planter pockets and planting material, at bottoms of artificial rock planter pockets.

F. Complete all sleeving for plumbing prior to shotcrete placement and concealment in artificial rockwork.

G. Clean plastic piping joints, pipe, and fittings with carbon tetrachloride before applying PVC cement.

H. Install hangers as required to ensure adequate structural support.

I. Fly Ash shall be substituted for cement from a minimum of 15 percent to a maximum of 20 percent by weight of cement.

J. Apply shotcrete to wall armatures at a minimum depth of 4” in thickness so that rebar is entirely enclosed by minimum of 2” shotcrete.

K. Cement curing: Surfaces shall be either

1. Sprayed or equivalent with water as soon as possible after shotcrete or other application without washing cement from surface and water-cured continuously thereafter for not less than 3 days, in such manner to keep surfaces continuously damp; or
2. Covered with polyethylene or equivalent, heated if required.

L. Waterproof outboard sides of shotcrete walls where large planting areas abut artificial rockwork.

M. Apply cement plaster texture coat directly to those areas of shotcrete or equivalent walls that are to be hand carved to a minimum thickness as noted on the drawings

N. Waterproof over smooth interior cement plaster coat of rockwork planters.

O. Waterproof as indicated on the drawings.

P. Paint all artificial rockwork to mimic photographs of natural formations, and sample mock-up panels, including the effects of minerals, intrusions, organic growth and of natural aging upon the environments. Minor adjustments to the final product shall be made at no increase in the Contract Sum.

3.05 FINAL COMPLETION

A. Contractor shall repair and patch all punchlist items to the satisfaction of the Architect.

B. Contractor shall carefully inspect all construction areas to remove all debris, particularly stones, steel bars, and other materials, which could harm the staff.

END OF SECTION

SECTION 040513

MORTAR

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes mortar used for stone wall barriers and other related masonry as shown on the Drawings.

B. Related Requirements

1. Section 033001, Cast-in-Place Concrete – Sitework
2. Section 313730, Native Stone Boulders – ALTERNATE #2

1.01 REFERENCES

A. Standards:

1. Mortar: ASTM C 270, except as otherwise specified.

2. Grout: ASTM C 476.

1.02 SUBMITTALS

A. Product Data:

1. Portland Cement: Brand and manufacturer's name.

2. Masonry Cement: Brand and manufacturer's name.

3. Lime: Brand and manufacturer's name.

4. Sand(s): Location of pit, name of owner, and previous test data.

5. Color Pigments: Brand and manufacturer's name.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials in a manner which will insure the preservation of their quality and fitness for the Work.

B. Store cement and lime on raised platforms under waterproof, well-ventilated cover.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cement: One of the following complying with the indicated requirements:

1. Portland Cement: ASTM C 150, Type 1, of natural color or white as required to produce the desired color.

2. Masonry Cement: ASTM C 91, of natural color or custom color as required to produce the desired color.

3. Cement for Setting Marble, Limestone, and Light Colored Granite: White cement complying with ASTM C 150, Type 1 or ASTM C 91, and non-staining to the stone.

B. Hydrated Lime: ASTM C 207, Type S.

C. Mortar Sand: ASTM C 144, except that for joints less than 1/4 inch thick use sand graded with 100 percent passing the No. 16 sieve.

1. Sand for White Mortar: Natural white sand or ground white stone.

2. Sand for Colored Mortar: Ground marble, granite, or other sound stone, as required to match approved sample.

D. Grout Sand: ASTM C 404.

E. Color Pigments: High purity, finely ground, chemically inert, unfading, lime proof mineral oxides specially prepared for use in mortar.

F. Water: Clean and free of deleterious amounts of acids, alkalis, and organic materials.

2.02 MIXES

A. Mortar for Cap Stone: Comply with ASTM C 270, proportion specifications, except limit materials to those specified.

1. Colored Mortar: Proportion color pigments with other ingredients as necessary to match required color, except limit pigments other than carbon black to a maximum of 10 percent of cement content by weight and limit carbon black to a maximum of 3 percent of cement content by weight.

B. Grout: Comply with ASTM C 476. If grout types are not indicated on Drawings, furnish type (fine or coarse) most suitable for the particular job conditions to completely fill cavities and embed reinforcement and other built-in items.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to sections of Specifications which require mortar and masonry grout.

END OF SECTION

METAL FABRICATIONS - SITEWORK

SECTION 055001

PART 1 GENERAL

1.00 GENERAL PROVISIONS

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

1.01 WORK INCLUDED

A. The work of this Section includes, but is not limited to the following:

1. Deadfall support and anchoring
2. Dig barrier

B. Products furnished, but not installed, under this Section include the following:

1. Anchor bolts, steel pipe sleeves, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect Work of this Section. Other Specification Sections that directly relate to Work of this Section include, but are not limited to:

1. Section 033001, CAST-IN-PLACE CONCRETE

1.03 REFERENCES

A. Comply with applicable requirements of following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Institute of Steel Construction (AISC):

Code	Code of Standard Practice for Steel Buildings and Bridges
Specification	Specification for the Design, Fabrication and Erection of Structural Steel for Buildings

2. American Iron and Steel Institute (AISI):

Specifications	Specifications for the Design of Light Gage Cold- Formed Steel Structural Members

3. American National Standards Institute (ANSI):

A14.3	Safety Requirements for Fixed Ladders
A202.1	Metal Bar Grating Manual

4. American Society for Testing and Materials (ASTM):

A 27	Steel Castings, Carbon, for General Application
A 36	Structural Steel

A 47	Ferritic Malleable Iron Castings
A 48	Gray Iron Castings
A 53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A 123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip
A 153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A 167	Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
A 312	Seamless and Welded Austenitic Stainless-Steel Pipe
A 307	Carbon Steel Externally Threaded Standard Fasteners
A 325	High Strength Bolts for Structural Steel Joints
A 385	High-Quality Zinc Coatings (Hot-Dip)
A 386	Zinc Coating (Hot-Dip) on Assembled Steel Products
A392	Zinc-Coated Steel Chain-Link Fence Fabric
A 446	Steel Sheet, Zinc-Coated (Galvanized) by the Hot- Dip Process, Structural (Physical) Quality
A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A 510	General Requirements for Wire Rods and Course Round Wire, Carbon Steel
A 569	Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
A 1011 / A1011M - 12b	Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra- High Strength
A 1008 / A1008M - 12a	Steel, Sheet, Cold-Rolled, Carbon, Structural, High- Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and
Bake Hardenable	
A 743	Castings, Iron-Chromium, Iron-Chromium Nickel, and Nickel-Base Corrosion-Resistant, General Application

A 780	Repair of Damaged Hot-Dip Galvanized Coatings
A 786	Rolled Steel Floor Plates

5. American Welding Society (AWS):

D1.1	Structural Welding Code - Steel
D1.3	Structural Welding Code - Sheet Steel
D1.6	Structural Welding Code – Stainless Steel

6. Corps of Engineers (CE):

CRD-C-621	Specification for Nonshrink Grout

7. Steel Structures Painting Council (SSPC):

PA 1	Paint Application Specification No. 1
SP 3	Power Tool Cleaning
SP 6	Commercial Blast Cleaning

1.04 SUBMITTALS

A. Samples: Samples of the following shall be submitted:

Item	Quantity and Size
Deadfall Support	One full size support fabricated and finished per drawings.
Dig Barrier	3’ x 3’ dig barrier panel with anchoring system per drawings

B. Shop Drawings: Submit shop drawings of work showing size and thickness of each member, type of material, method of connection and assembly. Show dimensions, clearances, anchorages, relationships to surrounding work, coatings, and other pertinent details of fabrication and installation.

C. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.

D. Product Data: Provide manufacturer's product data, installation instructions, use limitations, and recommendations for each material used. Provide certifications that materials comply with requirements.

E. Calculations: Where installed metal fabrication work is indicated to comply with certain design loadings, provide professionally prepared calculations, material properties, certification, and other information required for structural analysis of performance of work.

F. Welders Certification: Provide certifications, signed by Contractor, certifying that welders employed at project comply with requirements specified under AWS D1.1, AWS D1.2 and AWS D1.6.

1.05 GENERAL REQUIREMENTS

A. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.06 WORKMANSHIP

A. Miscellaneous metalwork shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.07 ANCHORAGE

A. Anchorage shall be provided where necessary for fastening miscellaneous metal items securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Provide products and materials of new stock, free from defects, and of best commercial quality for each intended purpose.

B. All fasteners shall be Type 316 stainless steel at exposed areas, otherwise provide hot-dip galvanized steel fasteners.

2.02 STEEL

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Steel Tubing: ASTM A 500 or A 501, hot or cold rolled, as required for design loading.

C. Steel Pipe: ASTM A 53, schedule 40, Type S (seamless), black except where galvanized is indicated, Grade A for cold-bending.

D. Steel Sheet: ASTM A 1011 or A 1008, grade required for design loading.

E. Iron Castings: ASTM A 47, or A 48, grade and class are manufacturer's options.

F. Bolts and fasteners: ASTM A 307 and A 325.

2.06 CHAIN LINK MESH

A. Steel Chain Link Mesh for Dig and Predator Barriers: 1.5” x 1.5” opening size x 11 gauge per ASTM A392, top selvage knuckle bottom selvage knuckle.

1. Zinc-Coated Steel Fabric: ASTM A392 hot dipped galvanized before or after weaving.
   a. Class 1 – 1.2 oz/ft^2 (366 g/m^2)
   b. Class 2 – 2.0 oz/ft^2 (610 g/m^2)

2.07 MISCELLANEOUS MATERIALS

A. Provide anchors, bolts, sockets, sleeves, and other parts required for securing each item of work to other construction. Furnish inserts and sleeves to be set into concrete formwork and concrete under Section 033001, CAST-IN-PLACE CONCRETE - SITEWORK.

B. Anchor Bolts:

1. Stainless-Steel Bolts and Nuts (All exposed conditions, when placed in concrete, and used in conjunction with pressure treated lumber): Regular hexagon-head annealed stainless-steel bolts, nuts and, where indicated, flat washers; ASTM F 593 (ASTM F 738M) for bolts and ASTM F 594 (ASTM F 836M) for nuts, Alloy Group 1 (A1).
2. Anchor Bolts (Galvanized steel – all other conditions): ASTM F 1554, Grade 36.
   a. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.
   b. Anchor bolts, bolts smaller than 5/8 in., and fasteners shall be steel castings conforming to ASTM A 307. Bolts larger than 5/8 in. shall conform to ASTM A 325.

C. Inserts: Threaded or wedge type, galvanized ferrous castings; either ASTM A 47 malleable iron, or ASTM A 27 cast steel. Provide threaded inserts and wedge inserts manufactured by one of the following or Director’s Representative approved equal:

1. Hohmann and Barnard.
2. Gateway Erections, Inc.
3. Richmond Screw Anchor Co.

D. Anchor Systems:

1. Expansion Anchors: Threaded stud type with two independent expansion anchor wedges per Fed. Spec. FF-S-325, Group II, Type 4, Class 1 for concrete expansion anchors. Stud, wedges, washer and nut shall be zinc-plated steel.
   a. Hilti Fastening Systems, "Kwick Bolt"
   b. Molly Fastener Group, Parabolt".
   c. Red Head, Phillips Anchors, "Wedge Anchors".
2. Adhesive Anchor System: Self-contained glass vial containing pre-measured amounts of quartz sand, hardening agent and polyester resin. Studs shall be threaded rod conforming to ASTM A307 with compatible washers and hexagon nuts furnished by the anchor manufacturer.
   d. Hilti Fastening System, "HVA".
   e. Molly Fastener Group, "Parabond".
   f. Ramset Fastening System, "Chemset".

E. Provide exposed fastenings of same material and finish as metal to which applied, unless otherwise noted.

F. Welding rods: Conform to AWS Standards and recommendations of welding rod manufacturer.

G. Epoxy Grout: Provide non-shrink, non-metallic, non-corrosive epoxy grout conforming to the following requirements:

1. Grout shall be manufactured specifically for use in supporting heavy loads.
2. Shrinkage at 28 days: None (0.00 shrinkage when tested in accordance with ASTM C827modified procedure) with a minimum effective bearing area (EBA) of 95 percent coverage of the tested base plate.
3. Compressive strength, minimum: 10,000 psi at seven days, when tested in accordance with ASTM C579.
4. Initial setting time: Approximately one hour at 70 degrees F.
5. Provide flowable consistency as necessary for the particular application.
6. Epoxy grouts which are volatile and which give off noxious fumes are not acceptable.

H. Epoxy Adhesive: ASTM C881, Type V, epoxy-based bonding agent.

2.08 FABRICATION - GENERAL

A. Fabricate work of this Section to be straight, plumb, level and square, and to sizes, shapes and profiles indicated on approved shop drawings. Ease exposed edges. Cut, reinforce, drill and tap metal work as required for proper assembly.

1. Fabricate miscellaneous supports, brackets, braces and the like required to fully complete the work.
2. Obtain loading requirements from suppliers of work to be supported. Design and support systems with a safety factor of at least 6 unless otherwise indicated.
3. Allow for thermal movement resulting from 100°F change in ambient temperature.
4. Shear and punch metals accurately. Remove burrs.
5. Ease exposed edges to a radius of approximately 1/32 in., unless indicated otherwise.
6. Form bent corners to smallest radius possible without causing grain separation or impairing work.
7. Remove sharp or rough areas on exposed traffic surfaces.
8. Weld seams continuously. Spot welding is permitted for temporary welding only.

B. Work Exposed to View: For work exposed to view, select materials with special care.

C. Provide materials which are smooth and free of blemishes such as pits, roller marks, trade names, scale and roughness. Fabricate work with uniform hairline joints. Form welded joints and seams continuously. Grind welds flush to be smooth after painting. For exposed fasteners, use hex head bolts or Phillips head machine screws.

D. Galvanizing: Hot-dip galvanize exterior metal fabrications and other items indicated to be galvanized, in compliance with ASTM A 123, ASTM A 153, or ASTM A 386. Provide minimum 1.5 oz./ft.2 zinc coating. Galvanize after fabrication.

E. Miscellaneous Bearing and Leveling Plate Fabrication: Provide miscellaneous loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Fabricate units flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts as required.

2.09 FINISHES

A. Steel: (Galvanized with Powder Coat)

1. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A 123/A 123M.
    a. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A 153/A 153M.
    b. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
2. Powder-Coat Finish: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
    a. Surface shall be mechanically cleaned and roughened with stainless steel sandblast for optimal coating adhesion and polyester powdercoated per German Industry Norm 50976 in non-lead, UV-stable, thermally-set polyester powder paints.
    b. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
    c. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
    d. Matching liquid paint shall be provided for field touch-up. Bolts and nuts shall be hot-dip galvanized or stainless steel only, for field painting.
    e. Color: TBD.
3. Do not powdercoat surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified finish in accordance with powdercoat manufacturer’s printed instructions.
4. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection and coat all field welds and connections with specified finish in accordance with powdercoat manufacturer’s printed instructions.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate and furnish anchorage devices, setting drawings, diagrams, templates, instructions, and directions for installation of concrete inserts, sleeves, anchor bolts, and miscellaneous items to be embedded or attached to concrete work, masonry work, or structural steel work.

3.02 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners necessary for securing work of this Section to in-place construction. Include threaded fasteners for concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors required.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installation of work of this Section.

C. Erect work square, plumb and true, accurately fitted, and with tight joints and intersections. All anchors, inserts and other members to be set in concrete or masonry shall be furnished loose by this trade to be built-into concrete and masonry by those trades. Avoid field cutting or drilling to greatest extent possible.

D. Brace work rigid and secure to surrounding construction. Provide temporary bracing or anchors where required.

E. Fit exposed connections accurately together to form hairline joints. Shop weld connections, except when work cannot be shop welded due to shipping size or galvanizing limitations.

F. Field Welding: Comply with AWS D1.1 and D1.2 for procedures of manual metal-arc welding, appearance and quality of welds, and correction methods for defective welds.

G. Where members other than expansion bolts or inserts are fastened into concrete, set such members in proprietary-type expanding grout manufactured specifically for such purpose. Use grouts strictly in accordance with manufacturer's directions. Form to receive members with galvanized metal sleeves, or other approved method to provide at least 1/2 in. clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 in. from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.

H. Electrolytic Isolation: Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

3.03 INSTALLATION

A. Deadfall Support: Install deadfall support as indicated on Drawings. Concrete shall be as specified in Section 033001, CAST-IN-PLACE CONCRETE - SITEWORK.

B. Dig Barrier: Install dig barrier as indicated on Drawings. Owner shall review and sign-off on installation and anchoring prior to backfill with habitat substrate.

C. Miscellaneous Bearing and Leveling Plates: Clean concrete and masonry surfaces of bond reducing materials. Roughen surfaces if required to improve bond to surface. Clean bottom surface of leveling plates immediately prior to installation.

1. Set loose leveling and bearing plates on wedges or other adjustable devices. Tighten anchor bolts after plates have been positioned plumb and level. Pack voids between plates and bearing surfaces solidly with specified grout.

D. Miscellaneous Items: Carefully review Drawings for miscellaneous metal items required by various trades but not specifically listed above, such as miscellaneous clip angles, miscellaneous steel bracketing, and other miscellaneous metal items as indicated on Drawings, reasonably implied there from, or reasonably necessary for thorough completion of work.

3.04 REPAIRING, CLEANING, AND PROTECTION

A. Non-Galvanized Surfaces: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed surfaces with same material as used for shop painting. Comply with SSPC PA 1.

B. Galvanized Surfaces: Clean welds, bolted connections and abraded areas and apply galvanizing repair paint in compliance with ASTM A 780.

C. Powdercoated Surfaces: Clean welds, bolted connections and abraded areas and apply powdercoat manufacturer’s liquid touch up paint.

3.05 QUALITY ASSURANCE

A. Shop fabricate work to greatest extent possible. Label each piece in shop to facilitate field assembly.

B. Welding: Perform welding in conformance with AWS D1.1, D1.3 and D1.6 as applicable.

3.06 PRODUCT HANDLING AND STORAGE

A. Store work off ground and under cover. Protect from damage. Repair and clean work before erection.

3.07 PROJECT CONDITIONS

A. Do not permit use of exterior metal fabrications until work is completely and fully installed and ready to assume intended design loads. Do not permit overloading of metal fabrication system.

END OF SECTION

SECTION 055213

EXTERIOR METAL RAILS AND GUARDRAILS

PART 1 GENERAL

1.00 GENERAL PROVISIONS

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

1.01 WORK INCLUDED

A. The work of this Section consists of furnishing and installing pipe rails, mesh fence, mesh gates, and view rails, as indicated on the Drawings and as specified herein.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033000 CAST-IN-PLACE CONCRETE

1.03 REFERENCES

A. Comply with applicable requirements of following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Society for Testing and Materials (ASTM):

A 36	Structural Steel
A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
A123	Zinc (Hot-Galvanized) Coatings on Products Fabricated from Rolled, Pressed, and Forged Steel Shapes, Plates, Bars, and Strip.
A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
A167	Stainless and Heat Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
A 307	Carbon Steel Externally Threaded Standard Fasteners
A 312	Seamless and Welded Austenitic Stainless Steel Pipe
A 325	High Strength Bolts for Structural Steel Joints
A 366	Steel, Carbon, Cold-Rolled sheet, Commercial Quality
A 385	High-Quality Zinc Coatings (Hot-Dip)
A 307	Carbon Steel Externally Threaded Standard Fasteners
A 312	Seamless and Welded Austenitic Stainless Steel Pipe
A 325	High Strength Bolts for Structural Steel Joints
A 366	Steel, Carbon, Cold-Rolled sheet, Commercial Quality
A 385	High-Quality Zinc Coatings (Hot-Dip)

A 386	Zinc Coating (Hot-Dip) on Assembled Steel Products
A 446	Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality
A 492	Specification for Stainless Steel Rope Wire.
A 500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
A 501	Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
A 510	General Requirements for Wire Rods and Course Round Wire, Carbon Steel
A 554	Welded Stainless Steel Mechanical Tubing
A 555	Stainless Steel Wire.
A 569	Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip Commercial Quality
A 570	Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality
A 588	High –Strength Low Alloy Structural Steel with 50 ksi [345 MPa] Minimum Yield Point to 4 in. [100mm] Thick
A 611	Steel, Cold-Rolled Sheet, Carbon, Structural
A 666	Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar
A 743	Castings, Iron-Chromium, Iron-Chromium Nickel, and Nickel-Base Corrosion-Resistant for General Application
E 894	Anchorage of Permanent Metal Railing Systems and Rails for Buildings
E 935	Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings

E 985 Specifications for Permanent Metal Railing Systems and Rails for Buildings

2. American Welding Society (AWS):

D1.1	Structural Welding Code - Steel
D1.6	Structural Welding Code – Stainless Steel

3. New York State Building Code

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, standard details, installation instructions, use limitations and recommendations for each material used. Provide certifications that materials and systems comply with specified requirements.

B. Shop Drawings: Submit stamped shop drawings prepared under the supervision of a registered Professional Engineer, including complete details and schedules for fabrication and shop assembly of each type railing and gate members, including details, schedules, procedures, and diagrams showing sequence of erection. Shop drawings shall not be made by using reproductions of Contract Drawings.

C. Samples:

1. Woven Mesh View Rail.
    a. Minimum 12 inch square mesh sample and each fitting and accessory proposed for the Project. Submit items in specified finish.
    b. 12” length of a cable
    c. Support Post: one full size post, with hardware to accept cable
    d. Toprail: one full size rail, with hardware to accept cable
2. Low Piperail and Piperail: Submit representative sample of material that is to be exposed in finished Work, showing full range of color and finish variations expected. Provide minimum 12 in. long finish samples of rail. Provide samples of exposed fittings and brackets.

D. Field Measurements: 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.

E. Calculations: Provide professionally prepared calculations and certification of the performance of this work. Indicate how design requirements for loading and other performance criteria have been satisfied.

1.05 MOCKUP

A. Rails:

1. Construct a full size mockup section on each type of rail on specified support structure before start of any rail work. Sample section shall exhibit proposed connections, finish and workmanship.
2. Sample section shall be inspected by the Architect. If the sample is not acceptable, construct additional panels, at no additional cost to the Owner, until an acceptable panel is constructed. Accepted panel; shall become the standard for the entire job and shall remain undisturbed until Substantial Completion.

1.06 GENERAL REQUIREMENTS

A. The Contractor shall verify all measurements and shall take all field measurements necessary before fabrication. Welding to or on structural steel shall be in accordance with AWS D1.1/D1.1M. Items specified to be galvanized, when practicable and not indicated otherwise, shall be hot-dip galvanized after fabrication. Galvanizing shall be in accordance with ASTM A 123/A 123M, ASTM A 653/A 653M, or ASTM A 924/A 924M, as applicable. Exposed fastenings shall be compatible materials, shall generally match in color and finish, and shall harmonize with the material to which fastenings are applied. Materials and parts necessary to complete each item, even though such work is not definitely shown or specified, shall be included. Poor matching of holes for fasteners shall be cause for rejection. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall provide strength and stiffness. Joints exposed to the weather shall be formed to exclude water.

1.07 WORKMANSHIP

A. Handrail and railing work shall be well formed to shape and size, with sharp lines and angles and true curves. Drilling and punching shall produce clean true lines and surfaces. Welding shall be continuous along the entire area of contact except where tack welding is permitted. Exposed connections of work in place shall not be tack welded. Exposed welds shall be ground smooth. Exposed surfaces of work in place shall have a smooth finish, and unless otherwise approved, exposed riveting shall be flush. Where tight fits are required, joints shall be milled. Corner joints shall be coped or mitered, well formed, and in true alignment. Work shall be accurately set to established lines and elevations and securely fastened in place. Installation shall be in accordance with manufacturer's installation instructions and approved drawings, cuts, and details.

1.08 ANCHORAGE

A. Anchorage shall be provided where necessary for fastening handrails and railings securely in place. Anchorage not otherwise specified or indicated shall include slotted inserts made to engage with the anchors, expansion shields, and power-driven fasteners when approved for concrete; toggle bolts and through bolts for masonry; machine and carriage bolts for steel; and lag bolts and screws for wood.

1.09 DISSIMILAR MATERIALS

A. Where dissimilar metals are in contact, or where aluminum is in contact with concrete, mortar, masonry, wet or pressure-treated wood, or absorptive materials subject to wetting, the surfaces shall be protected with a coat of bituminous paint or asphalt varnish.

1.10 QUALITY ASSURANCE:

A. Source: For each material type required for the work of this section, provide primary materials which are the product of one manufacturer. Provide secondary or accessory materials which are acceptable to the manufacturers of the primary materials.

B. Engineering: Provide services of Professional Engineer, registered in the State of New York, to design and certify that work of this Section meets or exceeds performance requirements specified.

C. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.6, "Structural Welding Code--Stainless Steel."

1.11 PERFORMANCE REQUIREMENTS

A. Structural Performances: Provide installed handrail and railing assemblies complying with following structural performances, unless otherwise indicated:

1. Live Loads shall not be less than the minimum required by applicable building codes.
2. Design shall incorporate safety factors as required by the applicable building codes.
3. Design and construction shall be as such to assure that under the required design live loads there shall be no failure of any member, deflection of not more than L/240 of length of any member, and without permanent deformation of any member or fastener.

B. Handrails and Guards: Handrails and guards shall be designed to resist a lateral load of 50 pounds per linear foot (plf) applied in any direction at the top and to transfer this load through the supports to the structure.

1. Concentrated Load: Handrails and guards shall be able to resist a single concentrated load 200 pounds, applied in any direction at any point along the top, and to transfer this load through the supports to the structure. This load need not be assumed to act concurrently with the uniform load specified above.
2. Components: Intermediate rails (all those except the handrail), balusters and panel fillers shall be designed to withstand a horizontally applied normal load of 50 pounds on an area equal to 1 square foot, including openings and space between rails. Reactions due to this loading are not required to be superimposed with those of the previous sections.

PART 2 PRODUCTS

2.01 STAINLESS STEEL

A. Tubing: ASTM A 554, Grade316L.

B. Pipe: ASTM A 312/A 312M, Grade316L.

C. Castings: ASTM A 743/A 743M, Grade CF 8M or CF 3M.

D. Sheet, Strip, Plate, and Flat Bar: ASTM A 666, Type 316L.

E. Bars and Shapes: ASTM A 276, Type 316L.

F. Stainless Steel Cable: 1/8 in. diameter.

G. Mesh: Type 304, 3/64 gauge

2.02 STAINLESS STEEL FASTENERS

A. Fastener Materials: Unless otherwise indicated, provide the following:

1. Stainless-Steel Items: Type 316 stainless-steel fasteners.
2. Dissimilar Metals: Type 316 stainless-steel fasteners.

2.03 STAINLESS STEEL MESH

A. Woven wire stainless steel mesh shall be ‘NETT’ EM’ supplied by A thru Z, Telephone: 520-434-8281 or Equal. See Drawings for opening size and gauge.

2.04 STEEL

A. Steel Plates, Shapes, and Bars: ASTM A 36.

B. Steel Tubing: ASTM A 500 or A 501, hot or cold rolled, as required for design loading.

C. Steel Sheet: ASTM A 366, A 570, or A 611, grade required for design loading.

D. Bolts and fasteners: ASTM A 307 and A 325.

E. Galvanizing: Hot-dip galvanize exterior metal fabrications in compliance with ASTM A 123, ASTM A 153, or ASTM A 386. Provide minimum 1.5 oz./ft.2 zinc coating. Galvanize after fabrication.

2.05 FASTENERS AND ANCHORS - GENERAL

A. Provide all anchors, bolts, sockets, sleeves, and other parts required for securing each item of work of this Section to the construction. Furnish required inserts and sleeves for installation in concrete under Section 033001, CAST-IN-PLACE CONCRETE - SITEWORK.

B. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.

C. Provide concealed fasteners for interconnecting components and for attaching ornamental metal items to other work, unless exposed fasteners are unavoidable.

1. Provide tamper-resistant screws for exposed fasteners, unless otherwise indicated.

D. Anchors: Provide cast-in-place anchors, fabricated from corrosion-resistant materials with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and equal to four times the load imposed when installed in concrete, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

E. Exposed fastenings shall be of the same material and finish as the metal to which applied, unless otherwise noted.

F. Welding rods shall conform to AWS Standards and the recommendation of the welding rod manufacturer. Welding of steel shall conform to AWS D1.1, D1.2 and D1.6.

2.06 GROUT

A. Epoxy Grout: Provide non-shrink, non-metallic, non-corrosive epoxy grout conforming to the following requirements:

1. Grout shall be manufactured specifically for use in supporting heavy loads.
2. Shrinkage at 28 days: None (0.00 shrinkage when tested in accordance with ASTMC827modified procedure) with a minimum effective bearing area (EBA) of 95 percent coverage of the tested base plate.
3. Compressive strength, minimum: 10,000 psi at seven days, when tested in accordance with ASTM C579.
4. Initial setting time: Approximately one hour at 70°F.
5. Provide flowable consistency as necessary for the particular application.
6. Epoxy grouts which are volatile and which give off noxious fumes are not acceptable.

2.07 ELECTROLYTIC SEPARATION

A. Coating for electrolytic separation between steel and concrete and grout shall be a high-build coal tar epoxy providing one coat protection for steel and concrete in a variety of chemical, immersion and underground conditions, manufactured by Tnemec Company, Inc., 6800 Corporate drive, Kansas City, MO 64120-1372; Tel. 816-483-3400; Kop-Coat Inc, 436 Seventh Avenue, Pittsburgh, PA 15219-1818; 1/412/227-2700, parent company RPM, International 2628 Pearl Road - P.O. Box 777 - Medina, Ohio 44258; Phone: 330.273.5090 - Fax: 330.225.8743; Carboline Company, 2150 Schuetz Road, St. Louis, MO 63146; Phone: 800-848-4645 or 314-644-1000; FAX: 314-644-4617, or approved equal.

2.08 FINISHES

A. Stainless Steel:

1. Remove tool and die marks and stretch lines or blend into finish.
2. Unless otherwise indicated, grind and polish surfaces to produce uniform finish indicated, free of cross scratches.
3. Run grain of directionally textured finishes with long dimension of each piece.
4. Directional Satin Finish: No. 4 finish.

B. Steel: (Galvanized with Powder Coat)

1. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A 123/A 123M.
   a. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A 153/A 153M.
   b. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
2. Powder-Coat Finish: Prepare, treat, and coat galvanized metal to comply with resin manufacturer's written instructions and as follows:
   a. Surface shall be mechanically cleaned and roughened with stainless steel sandblast for optimal coating adhesion and polyester powdercoated per German Industry Norm 50976 in non-lead, UV-stable, thermally-set polyester powder paints.
   b. Treat prepared metal with zinc-phosphate pretreatment, rinse, and seal surfaces.
   c. Apply thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm).
   d. Matching liquid paint shall be provided for field touch-up. Bolts and nuts shall be hot-dip galvanized or stainless steel only, for field painting.
   e. Color: TBD.
3. Do not powdercoat surfaces to be embedded in concrete, or to be welded in the field. After field welds are complete, grind smooth and flush, thoroughly clean and then apply specified finish in accordance with powdercoat manufacturer’s printed instructions.
4. After erection, sand smooth and retouch all portions of the shop coats chipped or damaged during erection and coat all field welds and connections with specified finish in accordance with powdercoat manufacturer’s printed instructions.

PART 3 EXECUTION

3.01 FABRICATION AND WORKMANSHIP

A. Metal surfaces shall be clean and free from mill scale, flake, rust and rust pitting; well-formed and finished to shape and size, true to details with straight, sharp lines and angles and smooth surfaces. Curved work shall be to true radii. Exposed sheared edges shall be eased.

B. Weld all permanent connections. Weld shall be continuous on all exposed surfaces and where required for strength on concealed surfaces. Exposed welds shall be ground flush and smooth, with voids filled with metallic filling compound (metallic filling compound not permitted on surfaces to receive hot-dip galvanizing). Tack-welding will not be permitted unless specifically called for. Do not use screws or bolts where they can be avoided. Where used, fastener heads shall be countersunk, screwed up tight, and threads nicked to prevent loosening.

C. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces. Fabricate work to be truly straight, plumb, level and square and to sizes, shapes, and profiles indicated on approved shop drawings. Ease exposed edges. Cut, reinforce, drill and tap metalwork as necessary for proper assembly and use.

1. Fabricate all miscellaneous metal supports, brackets, braces and the like required to fully complete the work of this Section.
2. Coordinate with work of other Specification Sections to ensure proper interface of various parts of the work.
3. Obtain loading requirements from suppliers of work to be supported and design and fabricate support systems with factor of safety of at least 6.

D. Form ornamental metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris. Take special care in choosing materials that are smooth and free of blemishes such as pits, roller marks, trade names, scale and roughness. Fabricate work with uniform, hairline tight joints. Form welded joints and seams continuously and grind flush and smooth to be invisible after painting. For exposed fasteners, use hex head bolts or Phillips head machine screws.

E. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Form simple and compound curves in bars and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

G. Do all cutting, punching, drilling, and tapping required for attachment of hardware and of work by other trades where so indicated or where directions for same are given prior to, or with approval of, shop drawings. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

H. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.

I. Provide weep holes where water may accumulate.

J. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items, unless otherwise indicated.

K. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.

L. Provide castings that are sound and free of warp, cracks, blowholes, or other defects that impair strength or appearance. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks.

M. Fastenings shall be concealed where practicable. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Joints exposed to weather shall be formed to exclude water.

N. Live loads shall be not less than the minimum required by law. In addition, the top railing shall be capable of resisting a force of 200 lbs. applied at any point in any direction. Design and construction shall be such as to assure that under these design live loads there shall be no failure of any member or connection, deflection of not more than L/360 of length of any member, and without permanent deformation of any member or fastener. Factor of safety shall not be less than 2-1/2 to 1.

3.02 INSTALLATION - GENERAL

A. Materials shall be carefully handled and stored under cover in manner to prevent deformation and damage to the materials and to shop finishes, and to prevent rusting and the accumulation of foreign matter on the metal work. All such work shall be repaired and cleaned prior to erection.

B. Work shall be erected square, plumb, and true, accurately fitted, and with tight joints and intersections. All anchors, inserts and other members to be set into concrete or masonry shall be furnished loose by this trade to be built-into concrete and masonry by those trades as the work progresses. Later cutting or drilling shall be avoided wherever possible.

C. Metal work shall be rigidly braced and secured to surrounding construction, and shall be tight and free of rattle, vibration, or noticeable deflection after installation.

D. Where members, other than expansion bolts or inserts, are fastened into concrete, set such members in proprietary-type expanding grout manufactured specifically for such purpose, used strictly in accordance with manufacturer's directions. Holes to receive members shall be formed with galvanized sheet metal sleeves, expanded polystyrene foam, or other approved method to provide at least 1/2 in. clearance around entire perimeter. At exposed applications, hold expanding grout back 1/2 in. from finish surface and fill voids with Portland cement grout to match color and texture of surrounding concrete surface.

E. Electrolytic Isolation: Where dissimilar metals are to come into contact with one another, isolate by application of a heavy coating of bituminous paint on contact surfaces in addition to shop coat specified above. Do not permit the bituminous paint in any way to remain on surfaces to be exposed or to receive sealant.

3.03 METAL HANDRAILS AND GUARDRAILS

A. Fabricate and install exterior metal handrails as called for on the Drawings.

B. Handrails, at all but mechanical and service areas, throughout, shall be of Architectural Quality. Exceptional care shall be taken in welding and grinding, filling and surface sanding to provide truly smooth, clean, neat and flush construction throughout, free of all surface defects and defacements.

C. Metal handrails shall be fabricated in accordance with the designs and configurations as called for on the Drawings. Sizes and shapes of all members shall be as indicated. Joints shall be full-welded and ground flush and smooth.

D. Include as part of this work all posts, intermediate rails, proprietary wall brackets, proprietary weld-on fittings (escutcheons, flanges, and returns, 90° corners, bends, crossovers, tees, etc.) anchors, and other items required for complete installations.

E. Installation of Metal Handrails: Unless otherwise indicated on the Drawings, installation shall be in pipe sleeves embedded in concrete and filled with epoxy grout with anchorage covered with standard pipe collar pinned to post.

END OF SECTION

SECTION 061000

ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Execution and completion of Rough Carpentry in accordance with the Specifications and Drawings including but not limited to;
   1. Dimensional lumber.

B. Related Sections:
   1. Division 01 Section "General Requirements."

1.3 REFERENCES

A. General:
   1. The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply.
   2. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the Work.
   3. Refer to Division 01 Section "General Requirements" for the list of applicable regulatory requirements.

B. ASTM International.

C. American Wood Preservers Association (AWPA).

D. Douglas Fir Protection Association (DFPA).

E. National Fire Protection Association (NFPA).

1.4 SUBMITTALS

A. Submit under provisions of Divisions 01 Section "General Requirements" and "Special Procedures."

B. Certificate: Provide certificate from each manufacturer stating that material is first quality, meets or exceeds the properties of specified materials as specified herein, and is suitable for intended use on this Project. Where recycled lumber materials are used for structural applications or where otherwise noted, include lumber certification and quality grading.

1.5 QUALITY ASSURANCE

A. Inspection: Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is completed to the point where this installation may properly commence.

B. Discrepancies: In the event of discrepancy, immediately notify the Project Manager. Do not proceed with installation in areas of discrepancy until such discrepancies have been fully resolved.

C. Lumber may be rejected by the Project Manager, whether or not it has been installed, for excessive warp, twist, bow, crook, mildew, fungus, or mold, as well as for improper cutting and fitting.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Materials shall be properly packed and handled while in transit so as to arrive at the job site in undamaged condition. Manufactured materials shall be delivered in suitable containers plainly marked with brand and manufacturer's name.

B. Storage arrangements shall be subject to Project Manager's approval and shall afford every access for inspection and identification of each item. Lumber shall be piled off the ground, on skids, in a manner which prevents twisting or warping and affords proper ventilation, drainage and protection from termites and decay, rain and excessive sun. Plywood shall be protected from dampness. Material shall be protected from the elements and from damage or deterioration.

C. Damaged or deteriorated materials or assemblies shall not be used in the work and shall be replaced at no extra cost to University.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Material shall conform to these specifications and to the applicable current editions of the Standard Specifications of ASTM and CBC. [The source of new lumber shall be certified sustainable harvested lumber.]

B. Lumber Grading:
1. Douglas Fir: "Standard Grading and Dressing Rules," No. 17, West Coast Lumber Inspection Bureau.
2. Redwood: "Standard Specifications for Grades of Redwood Lumber" as issued by California Redwood Association.

C. Lumber Grade Marking: Each piece of lumber shall bear the official grade mark of the appropriate inspection bureau of the American Lumber Association, California Redwood Association, WCLIB, etc.

D. Lumber Size and Patterns: Surface four sides, dress sizes to UBC Chapter 23; work to sizes shown. Sizing and surfacing shall be as required and approved for the particular location. Framing shall be sized and where exposed shall be surfaced.

E. Dimensional lumber 2 inches (50 mm) or less in thickness shall have an average moisture content of 19 percent or less but no portion of a shipment shall be over 25 percent. Air dried lumber is desired but, if necessary, lumber may be kiln dried, however, the drying process must be slow and regulated to cause only an amount of checking comparable with air-dried stock. Wood thicker than 2-1/2 inches (63 mm) shall be well seasoned stock, moisture content not to exceed 18 percent.

F. Sills and equipment curbs which rest on concrete shall be foundation grade Redwood or preservative pressure treated Douglas Fir.

G. Framing, blocking, backing, etc., unless otherwise shown, shall be Douglas Fir. All interior wood and plywood used for blocking and built into roofing, or otherwise shown shall receive fire retardant pressure treatment in accordance with paragraph 2.5.B. Exterior stair framing and decking, and wood exposed to the exterior, or otherwise shown, shall receive the preservative type pressure treatment in accordance with paragraph 2.5.A.

2.2 LUMBER FASTENINGS (EXCEPT FOR PRESERVATIVE PRESSURE TREATED LUMBER FASTENINGS)

A. Nails and Spikes: Common Wire unless otherwise noted
1. Nailing of wood members shall conform to Uniform Building Code and/or as indicated. Box nails are not permitted.
2. Penetration: half-length of nail into piece receiving point.
3. To connect pieces 2 inches (25 mm) net in thickness, 16d nails may be used.
4. Do not drive nails closer together than half their length, nor closer to edge of piece of lumber or timber than 1/4 their length.
5. Spacing and size of nails to be such that splitting will not occur. Pre-bore holes for nails wherever necessary to prevent splitting. Bore diameter of holes smaller than diameter of nail or spike (3/4 dia.).
6. Use galvanized nails where exposed to weather or where members are built-in to roofing.

B. Screws: Bright steel wood screws:
1. Screws are to be turned into place, not driven. Self-tapping where required for fastening to metal framing.
2. Countersink where heads will interfere or as required.
3. Screw bolt holes the same diameter and depth as shank; bore holes for threaded portion of screws with bit no larger than base of thread.
4. Use galvanized or cadmium plated screws on fastenings exposed to weather or where members are built-in to roofing.

C. Bolts: Standard mild steel, square or hex head machine bolts with square nuts and malleable iron or steel plate washers, conforming to ASTM A307.
1. To be installed in drilled holes the diameter of the bolt, 1/32 inch (0.8 mm) to 1/16-inch (1.6 mm) over size.
2. Bolting of wood members shall conform to CBC requirements and as called for on the drawings.
3. Washers: Provide bolts bearing on wood, unless noted otherwise on the drawings, with malleable iron, or steel plate washers under heads and nuts. Do no final bolting until structure has been properly aligned.
4. Use galvanized bolts, nuts and washers where exposed to weather or where members are built-in to roofing.

D. Lag Screws: Conform to "National Design Specification for Stress Graded Lumber and Its Fastenings," NFPA, latest edition.
1. Lag screws shall be screwed and not driven into place. Penetration in each timber shall not be less than 2/3 of the length of the lag screw.
2. Hole shall be bored the same diameter and depth as the shank, after which the hole shall be continued to a depth equal to the length of the lag screw with a diameter no larger than 3/4 of the shank diameter.
3. Washers: Provide lag screws bearing on wood with malleable iron or steel plate washers under heads.

4. Use galvanized lag screws and washers where exposed to weather or where members are built-in to roofing.

2.3 ROUGH HARDWARE (EXCEPT FOR PRESERVATIVE PRESSURE TREATED LUMBER FASTENINGS)

A. Provide rough hardware related to carpentry work which is not specifically called out under other headings. This shall include, but not be limited to, the following:
   1. General: Fastenings, devices, and other rough hardware not specifically indicated on drawings or specified herein shall be submitted for approval prior to installation. Conform to ASTM A7 or A36.
   2. Framing clips, hangers, etc.: Standard products of Universal Company, Simpson, or Silver.
   3. Sheet metal straps: Galvanized sheet steel of gauges and designs indicated.
   4. Expansion anchors shall have a current ICC evaluation report and be size, number and type shown, installed as described in the evaluation report.
   5. Powder Driven Fasteners: shall have a current ICC evaluation report and be size, number and type shown, installed as described in the evaluation report.

2.4 PRESSURE TREATMENT

A. Where called for on the drawings or specified herein, exposed lumber to receive preservative-type pressure treatment shall have a minimum moisture content of 19 percent after pressure treatment and shall be pressure treated using Ammoniacal copper quaternary compound (ACQ). Preservative shall penetrate a minimum of 3/8-inch (9.5 mm) deep into wood. Materials shall be compatible with stain coatings when specified in Division 09 Section "Painting". Fasteners and connectors used with preservative pressure treated lumber shall be G185 hot dip galvanized, Type 304 stainless steel or Type 316 stainless steel.
   1. Dimensioned Lumber Posts: AWPA C-2, retention of 0.4 lbs/c.f. per quality standard for LP-22 for in-ground contact.
   2. Dimensioned Lumber (all other): AWPA C-2, retention of 0.25 lbs/c.f. per quality standard LP-2 for above ground use.
   3. Pre-treated lumber shall be preserved with ACQ Preserve®, Chemical Specialties Inc.

PART 3 - EXECUTION

3.1 WORKMANSHIP

A. General: Rough carpentry shall produce joints true, tight, and well nailed with members assembled in accordance with the Drawings and with pertinent codes and regulations.

B. Selection of lumber pieces: Carefully select members. Select individual pieces so that knots and obvious defects will not interfere with placing bolts or proper nailing or making proper connections.

3.2 WOOD PRESERVATIVE

A. All exterior framing and wood trims coming in contact with concrete or masonry, whether or not Redwood, and not specified or otherwise shown to be pressure treated shall be treated with ACQ Preserve®.

B. Install framing in strict accordance with the requirements of CBC Chapter 23 unless more stringent requirements are specified herein or shown on the Drawings.

3.3 CLEANUP

A. At the end of each shift and upon completion of the work, remove debris, rubbish and surplus materials from the site which resulted from work under this section. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill. Take positive measures to ensure that saw dust and wood shavings do not enter the storm drainage system.

3.4 WASTE MANAGEMENT

A. Conform with Division 01 Section “Construction Waste Management.”

B. Separate wood waste in accordance with the Waste Management Plan.

C. Separate stained, painted and treated lumber from clean lumber and place in designated area for hazardous materials.

D. Separate and store separately in a clean and dry location the following categories for salvage or re-use on site:
1. Sheet materials larger than 2 square feet (1.19 m).
2. Framing members larger than 16 inches (400 mm).
3. Multiple offcuts of sizes larger than 12 inches (300 mm).

E. Set aside damaged wood for acceptable alternative uses, for example use as bracing, blocking, cripples, or ties.

F. Do not burn in an open fire, wood stove, fireplace or other non-industrial incinerator lumber that is less than a year old or wood treated with creosote, pentachlorophenol, CCA, ACA, or other pressure treatment.

G. Separate the following categories for disposal and place in designated areas for hazardous materials: treated, stained, painted, or contaminated wood.

H. Sequence work to minimize use of temporary HVAC to dry out building and control humidity.

END OF SECTION 061000

SECTION 061053

EXTERIOR ROUGH CARPENTRY

PART 1 GENERAL

1.01 GENERAL PROVISIONS

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

1.02 WORK INCLUDED

A. Provide all rough carpentry work for as indicated on the Drawings and as specified herein. Rough carpentry shall include but not be limited to:

1. Rough hardware, inserts, and related metal components, for work of this Section, except those items specifically specified to be provided by other trades.
2. Rough carpentry framing, sleepers, blockings, nailers, etc., required for wood deck construction
3. Deck support framing.
4. Wood preservative treatments and applications.
5. Other usual items of normal rough carpentry work indicated on the Drawings or necessary for the proper completion of the Project, even though not specifically mentioned herein.

1.03 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033001, CAST-IN-PLACE CONCRETE – SITEWORK
2. Section 055213, EXTERIOR METAL RAILS AND GUARDRAILS
3. Section 061500, WOOD DECKING

1.04 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive shall govern:

1. American National Standards Institute (ANSI):
   A199.1 Construction and Industrial Plywood

2. American Plywood Association (APA):
   Ref. 1 APA Design/Construction Guide, Residential and Commercial

3. American Society for Testing and Materials (ASTM):
   A 153 Zinc Coating (Hot-Dip) on Iron and Steel Hardware

   D 245 Structural Grades and Related Allowable Properties for Visually Graded Lumber

D 2898 Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing

E 84 Surface Burning Characteristics of Building Materials

4. Federal Specifications (Fed. Spec.):
   UU-B-790 Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellent, and Fire Resistant)

5. U.S. Department of Commerce (USDC):
   PS 1 Plywood

   PS 20 American Softwood Lumber Standard

1.05 DEFINITIONS

A. Boards: Lumber of less than 2 inches nominal (38 mm actual) in thickness and 2 inches nominal (38 mm actual) or greater width.

B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) or greater but less than 5 inches nominal (114 mm actual) in least dimension.

C. Timber: Lumber of 5 inches nominal (114 mm actual) or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.06 SUBMITTALS

A. Shop Drawings: Submit shop drawings of exterior 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.

B. Samples: Submit representative samples of all materials for use under this Section.

C. Product Data: Submit product data consisting of manufacturer’s product description and specifications.

D. Certificates: Submit certificates of grading, treatment, and conformance to specified standards. Certifications shall state date of treatment, conformance with Specifications, and agency grading of wood.

1. For lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by ALSC's Board of Review.

2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.07 QUALITY ASSURANCE

A. Provide lumber and plywood bearing the grade-trademark of the association under the rules or standards of which it was produced. Grade-trademarks shall conform to the rule or standard under which the material is produced, including requirements for qualifications and authority of the inspection organization, usage of authorized identification, and information included in the identification.

1. Grades specified are the minimum acceptable. Lumber grades shall be determined in accordance with ASTM D 245.
2. Lumber shall bear the grade mark of an American Lumber Standards Committee, Board of Review-approved agency. Lumber shall conform to USDC PS 20.
3. Lumber shall bear a mark of mill identification.
4. Plywood shall comply with APA Ref. 1 grading requirements, USDC PS 1, and ANSI A199.1.

B. Forest Certification: Provide wood products obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship."

1.08 COORDINATION

A. Coordinate the work of this Section with the work of other Sections to assure the steady progress of all the work of the Contract.

1.09 PRODUCT DELIVERY AND STORAGE

A. Stack and store materials above ground under protective coverings, or indoors in such a manner to insure proper drainage, ventilation, and protection. Do not place kiln dried materials in the building until concrete and masonry work have been completed, and are sufficiently dry.

B. Store rough carpentry materials stickered in elevated piles to allow for air circulation below. Wrapped lumber completely, including bottoms, in waterproof tarps. Tie tarps down to protect against wind blow-off. Stored lumber in covered storage trailers during project delays

PART 2 PRODUCTS

2.01 LUMBER, GENERAL

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

1. Factory mark each item with grade stamp of grading agency.
2. For items that are exposed to view in the completed Work, mark grade stamp on end or back of each piece.

3. In DOC PS 20, dressed sizes of green lumber are larger than dry lumber.
4. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
5. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 PRESERVATIVE

A. Pressure Type: Preservative: Wolman® E copper azole; provided by Arch Treatment Technologies, Inc., 1955 Lake Park Drive, Suite 250 Smyrna, GA 30080; Tel:770.801.6600;E-mail: info@wolmanizedwood.com • Web: www.wolmanizedwood.com, or approved equal.

1. Lumber shall be pressure treated with copper azole, conforming to AWPA P5, and AWPA Standard C1. Retention shall be CBA-A, at least .41 lb. of dry salts per cu. ft. of wood; specified standard for agriculture, farm use, building construction material, fences, highway material and decks in contact with the ground. Supply certificate of treatment to Director's Representative.
2. Treatment: In accordance with the requirements of AWPA Standard C1 and in accordance with the following standards for indicated end uses:
    a. Lumber: C2.
3. Treated wood shall be redried before installation to a moisture content of 19% or less and all field cuts shall be brush treated with the preservative material in accordance with AWPA M4.
4. Under no circumstances shall creosote, copper sulfate, or mercuric chloride preservative be used.

2.03 DIMENSION LUMBER

A. Maximum Moisture Content: maximum 12 percent for 2-inch nominal (38-mm actual) thickness or less; maximum 12 percent for more than 2-inch nominal (38-mm actual) thickness.

B. Exposed Lumber: Provide material hand selected for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

C. Boardwalk Framing: Construction or No. 2 grade and any of the following species:

1. Hem-fir (North); NLGA.
2. Southern pine; SPIB.
3. Douglas fir-larch; WCLIB or WWPA.

D. Dimension Lumber Posts: Construction or No. 2 grade and any of the following species:

1. Hem-fir or hem-fir (North); NLGA, WCLIB, or WWPA.
2. Douglas fir-larch, Douglas fir-larch (North), or Douglas fir-south; NLGA, WCLIB, or WWPA.
3. Mixed southern pine; SPIB.

2.04 BOARDS

A. Maximum Moisture Content: 19 percent.

B. Provide boards hand selected for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.

C. Board Decking: Owner provided, see Section 061500, WOOD DECKING for fasteners.

2.05 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

1. Use stainless steel fasteners for all exposed conditions. Refer to “General Structural Notes” on Drawing Sheet S1.00.

B. Nails: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272. D. Wood Screws: ASME B18.6.1.

D. Lag Screws: ASME B18.2.1 (ASME B18.2.3.8M).

E. Stainless-Steel Bolts: ASTM F 593, Alloy Group 1 or 2 (ASTM F 738M, Grade A1 or A4); with ASTM F 594, Alloy Group 1 or 2 (ASTM F 836M, Grade A1 or A4) hex nuts and, where indicated, flat washers.

F. Expansion Anchors: Stainless-steel anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Stainless-steel 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).

2.06 METAL FRAMING ANCHORS

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

1. Cleveland Steel Specialty Co.
2. Harlen Metal Products, Inc.
3. KC Metals Products, Inc.
4. Simpson Strong-Tie Co., Inc.
5. Southeastern Metals Manufacturing Co., Inc.
6. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Stainless-Steel Sheet: ASTM A 666, Type 316.

D. Joist Hangers: U-shaped, with 2-inch- (50-mm-) long seat and 1-1/4-inch- (32-mm-) wide nailing flanges at least 85 percent of joist depth.

E. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.

F. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch (25 mm) above base and with 2-inch- (50-mm-) minimum side cover, socket 0.062 inch (1.6 mm) thick, and standoff and adjustment plates 0.108 inch (2.8 mm) thick.

G. Joist Ties: Flat straps, with holes for fasteners, for tying joists together over supports.

2.07 MISCELLANEOUS MATERIALS

A. Provide hammer drive anchors and fasteners for securing wood framing, blocking or plywood into masonry of sufficient length to penetrate the receiving member a minimum of 1-1/2 in.

PART 3 EXECUTION

3.01 ROUGH CARPENTRY WORK, GENERAL

A. Refer to Drawings to determine the major extent of the rough carpentry work required.

B. The Contractor shall be responsible for structural integrity, connections, and anchorage of rough carpentry work.

C. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, not adequately seasoned, or too small to fabricate.

D. Set rough carpentry work to required levels and lines, with members plumb and true to line, cut and fitted.

E. Provide wood sleepers, blockings, curbs, cants, edgings, grounds, nailers, and furring where required for screeding or attachment to other work. Coordinate locations with other work to be supported.

F. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces.

G. Provide permanent grounds of dressed, preservative treated, key-bevelled lumber not less than 1-1/2 in. wide, and of thickness required.

H. Unless indicated otherwise, blockings, nailers, etc., of 2 in. nominal thickness or greater shall be bolted to back-up material with 1/2 in. bolts (galvanized at exterior locations and at roofs) located 4 in. from ends and splices, and spaced not greater than 32 in. on center along lengths of the members. Provide nails of sufficient length to penetrate receiving member a minimum of 1-1/2 in.

I. Unless indicated otherwise, secure 2 in. thick or smaller wood framing, nailers, furring, etc., to back-up material by use of appropriate fasteners located 4 in. from ends and spaced not greater than 16 in. on center along lengths of the members. Provide type and length of fastening devices to develop positive and secure anchorage to the back-up material.

J. Butt joints in wood shall be flush to provide smooth, uniform line with no irregularities. Built-up blocking shall have butt joints staggered 4 in. minimum layer to layer. The minimum length of any individual piece of lumber shall be 12 in. Lengths of lumber shall have a minimum of four fasteners.

K. Construct all rough carpentry work plumb, level, and true with tight, close fitting joints, securely attached and braced to surrounding construction. Counterbore for bolt heads, nuts, and washers where required to avoid interference with other materials.

L. Repair all damage caused by nailing, drilling, or powder-driving into concrete or masonry.

3.02 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.03 PREPARATION

A. Clean substrates of projections and substances detrimental to application.

3.04 INSTALLATION, GENERAL

A. Set exterior rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit exterior rough carpentry to other construction; scribe and cope as needed for accurate fit.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction" unless otherwise indicated.

C. Install Owner provided wood decking with crown up (bark side down).

D. Secure decking to framing with concealed decking fasteners.

E. Install metal framing anchors to comply with manufacturer's written instructions.

F. Do not splice structural members between supports unless otherwise indicated.

G. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.

1. Use inorganic boron (SBX) for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach exterior rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2305.2, "Fastening Schedule," in BOCA's BOCA National Building Code.

K. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.

L. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

M. Indicate locations of other fasteners, such as wood screws, bolts, and lag screws, on Drawings.

3.05 WOOD DECK JOIST FRAMING INSTALLATION

A. General: Install joists with crown edge up and support ends of each member with not less than 1-1/2 inches (38 mm) of bearing on wood or metal, or 3 inches (76 mm) on masonry. Attach floor joists where framed into wood supporting members by using wood ledgers as indicated or, if not indicated, by using metal joist hangers. Do not notch joists.

B. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds 48 inches (1200 mm).

C. Lap members framing from opposite sides of beams or girders not less than 4 inches (102 mm) or securely tie opposing members together. Provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist over supports.

D. Unless otherwise required by state building code, provide solid blocking of 2-inch nominal (38-mm actual) thickness by depth of joist at intervals of 96 inches (2438 mm) o.c., between joists.

3.06 FASTENING OF WOODWORK

A. Fasten wood to masonry with hammer driven anchors through predrilled holes spaced 8 in. on center maximum. Predrill the hole, insert fastener sleeve, and secure in place with nail.

B. Install plywood on masonry surfaces hammer driven anchors through predrilled holes spaced 12 in. on center along the top and bottom edges. Keep fasteners 3 in. minimum from the board edge. Drive fastener heads flush with surface. Secure plywood to wood substrate with nails at same spacing as hammer driven anchors. Secure plywood to metal studs with screws approved by metal stud manufacturer.

C. Installation and nailing of plywood sheathing shall be in strict accordance with the published specifications and recommendations of the American Plywood Association (APA), including APA Ref. 1.

3.07 CLEANING

A. Upon completion of rough carpentry work in any given area, remove all rubbish and debris from the work area and leave in broom clean condition.

END OF SECTION

SECTION 061500

WOOD DECKING

PART 1 GENERAL

1.01 GENERAL PROVISIONS

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

1.02 WORK INCLUDED

A. Provide all equipment and materials except where materials are noted 'provided by Owner', and do all work necessary to furnish and install the wood decking as indicated on the Drawings and as specified herein.

1.03 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 055213, EXTERIOR METAL HANDRAILS AND GUARDRAILS.
2. Section 061053, EXTERIOR ROUGH CARPENTRY;

1.04 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirement shall govern.

1. American Society for Testing and Materials (ASTM):

A 153	Zinc - Coating (Hot-Dip) on Iron and Steel Hardware
A 325	High Strength Bolts for Structural Steel Joints
D 245	Structural Grades and Related Allowable Properties for Visually Graded Lumber

2. American Wood Preservers' Bureau (AWPB):

LP-22	Pressure Treated with Waterborne Preservatives

1.05 QUALITY ASSURANCE

A. Materials and workmanship shall conform to governing laws and building code.

1. Mill and Producers Mark: Each piece of lumber shall be grade stamped indicating type, grade, mill, and grading agency certified by the Board of Review of the American Lumber Standards Committee. Mark shall appear on unfinished surface or ends of pieces with finished surfaces.

1.06 SUBMITTALS

A. Submit shop drawings indicating profiles, sizes, connection attachments, and types of fasteners.

B. Product Data: Submit product data to Director's Representative for approval, consisting of complete manufacturers product description and specifications.

C. Certificates: Submit certificates of grading, treatment, and conformance to specified standards. Certifications shall conform to AWPB LP-22 Paragraph 5.

1.07 COORDINATION

A. Work under this section shall be properly coordinated with the work of other sections to assure the steady progress of all the work of the Contract. PRODUCT DELIVERY AND STORAGE

B. Materials when delivered to site shall be stacked and stored above the ground under protective coverings or indoors in such manner as to insure proper drainage, ventilation, and protection.

C. Wood decking materials shall be stored on elevated piles to allow for air circulation below and tipped in one direction to effectively drain moisture. Lumber shall be wrapped completely, including bottoms, in waterproof tarps. Tarps shall be tied down to protect against wind blow-off. Should delays in Project be anticipated, lumber shall be stored in covered storage.

PART 2 PRODUCTS

2.01 DECKING LUMBER – PROVIDED BY OWNER

A. Decking shall be 5/4" X 8" Black Locust

1. Grade:
    a. No. 1 Premium Select Grade Black Locust as graded by the National Hardwood Lumber Association.
    b. 100% Dried, Straight & True
    c. Facing Surface 80% Clear
    d. Zero Checking
    e. Zero Wane or Shake
2. Material Length (Installed) as indicated on drawings.
    a. The 5/4" X 8" Black Locust Decking boards are to be milled and installed as to span the entire length of the exterior joists and as one solid piece with no saw cuts along the span.

2.02 DECKING HARDWARE

A. Exposed Areas: Provide stainless steel hardware required to complete this work and to attach this work in a secure and rigid manner to work of this and other trades, including all brackets, anchors, anchor bolts, thru bolts, washers, nuts, nails, and other hardware. Assist other trades as necessary in the placement of brackets and anchor bolts in concrete and furnish full instructions regarding locations, sizes, and other requirements of the items in order that they may properly prepare their work to receive same. Rough hardware shall comply in all respects with requirements of the governing laws and codes.

B. Fastening screws for decking shall be Swaneze self-drilling #7 trim head stainless steel screws manufactured by Swan Secure Products, Inc., 960 Turnpike Street; Canton, MA 02021; 877-792-6732 Tel. 781-828-1033 Fax, or approved equal.

C. Fastening screws for decking shall be “Woodpeckers” Flat Head, 6 Lobe Drive and “Woodpeckers” Finishing, 6-Lobe drive Trim Head, Hand-Drive stainless steel screws manufactured by Swan Secure Products, Inc., 7525 Perrymann Court, Baltimore, MD 21226; 800-966-2801 Tel; 410-360-2288; Fax (1-800-847-4714), or approved equal.

1. Screws shall be sized so they penetrate not less than 1-1/2 inches (38 mm) into wood substrate. Fastening Screws for starter boards, end boards, steps & facias shall be one of the following, or approved equal.
2. Fastening screws for decking shall be Swaneze self-drilling #7 trim head stainless steel screws manufactured by Swan Secure Products, Inc., 960 Turnpike Street; Canton, MA 02021; 877-792-6732 Tel. 781-828-1033 Fax, or approved equal.
3. Fastening screws for decking shall be HEADCOTE® color coated trim screws, manufactured by Starborn Industries, Inc., Avenel, NJ 07001; Email: info@starbornindustries.com; Phone: 1-800-596-7747; or approved equal.
    a. Headcote® #8 x 2-1/2"color coated trim screws, including one Smart- Bit® pre-drilling and countersinking tool and one #2 square drive insert bit.
    b. Type 305 Stainless Steel with countersinking nibs, square drive recess and type 17 notched point
    c. Highly durable epoxy-based finish.
    d. Colors shall match decking material
4. Screws shall be sized so they penetrate not less than 1-1/2 inches (38 mm) into wood substrate.

2.03 HIDDEN FASTENERS

A. Tiger Claw TC-4, stainless steel fasteners with black oxide coating, manufactured by Tiger Claw Inc., 400 Middle Street, Suite J Bristol, CT 06010 -8405; Tel. 800-92-TIGER; (800/928-4437) toll free, or approved equal. Fasteners shall be specifically designed for use with iron wood decking materials up to 4 in. wide. Fasteners shall include black oxide stainless steel screws.

2.04 HANGERS

A. Hangers and connectors shall be as indicated below, manufactured by Barclay Simpson Simpson Manufacturing Co., Inc. 5956 W. Las Positas Blvd. Pleasanton, CA 94588; Tel: (925) 560-9032, or approved equal:

1. Simpson Strong Tie Stainless Steel Connectors for bridge and deck
2. LUS26-2SS Joist Hangers
3. ABU44SS Post Base
4. LS50SS Skewable Angle

2.05 SEALER

A. Sealer for wood decking shall be per the Manufacturer's recommendations.

2.06 BUILDING FELT AND PROTECTIVE PAPER

A. Building felt for general use where freedom from staining is non-essential shall be 15 lb. asphalt-saturated felt conforming to ASTM D 226, Type I.

PART 3 EXECUTION

3.01 WOOD DECKING

A. Wood decking work required shall include all work, regardless of whether or not each and every item is specifically called for. Refer to Drawings to determine the major extent of the wood decking work required.

B. The Contractor shall be responsible for structural integrity, connections, and anchorage of wood decking work.

C. Discard units of material which are unsound, warped, bowed, twisted, improperly treated, or not adequately seasoned. Structural members shall be full-length without splices.

3.02 FASTENING OF WOOD MEMBERS

A. Wood decking shall be secured to wood joists with hidden fasteners spaced as indicated on the Drawings, minimum of two at each support. Screw heads shall be predrilled, screwed at 15-degree angle and pegged in accordance with decking suppliers' printed instructions.

B. Wood decking starter boards shall be secured to wood joists with screws spaced as indicated on the Drawings, minimum of two at each support. Screw heads shall be predrilled, screwed at 15-degree angle and pegged in accordance with decking suppliers' printed instructions.

3.03 SEALER

A. Decking shall be sealed in accordance with manufacturer's printed instructions.

3.04 CLEANING

A. Upon completion of wood decking work in any given area, remove all rubbish and debris from the work area and leave in clean condition.

END OF SECTION

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.1 Related documents

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

1.2 SUMMARY

A. This Section includes the following:

1. Wall sheathing.
2. Roof sheathing.
3. Building paper.
4. Building wrap.
5. Sheathing joint-and-penetration treatment.

1.3 QUALITY ASSURANCE

A. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":

1. Plywood.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS, GENERAL

A. Plywood:

2.2 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

B. Foil-Faced, Polyisocyanurate-Foam Wall Sheathing: ASTM C 1289, Type I, Class 2, aluminum-foil-faced, glass-fiber-reinforced, rigid, cellular, polyisocyanurate thermal insulation. Foam-plastic core and facings shall have a flame-spread index of 25 or less when tested individually.

1. Thickness: refer to Drawings.

2.3 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated.

1. For wall and roof sheathing panels, provide fasteners with corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.5 WEATHER-RESISTANT SHEATHING PAPER

A. Building Paper: ASTM D 226, Type 1 (No. 15 asphalt-saturated organic felt), unperforated.

B. Building Wrap: ASTM E 1677, Type I air retarder; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
b. DuPont (E. I. du Pont de Nemours and Company); Tyvek [CommercialWrap] [StuccoWrap] [HomeWrap] [HomeWrap and HeaderWrap].
c. Ludlow Coated Products; [Air Stop Housewrap] [Barricade Building Wrap] [EnergyWrap Housewrap] [R-Wrap Protective House Wrap].
d. Pactiv, Inc.; GreenGuard [Classic Wrap] [RainDrop] [Ultra Wrap] [Value Wrap].
e. Raven Industries Inc.; Rufco-Wrap.
f. Reemay, Inc.; Typar HouseWrap.
g. Approved equal

C. Building-Wrap Tape: Tape recommended by building-wrap manufacturer.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with ASTM D 3498 that is approved for use indicated by manufacturers of both adhesives and panels.

1. Use adhesives that have a VOC content of 50> g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Flexible Flashing: Self-adhesive, rubberized-asphalt compound, bonded to a high-density, polyethylene film to produce an overall thickness of not less than 0.025 inch (0.6 mm).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's "Uniform Building Code."
4. Table 2305.2, "Fastening Schedule," in BOCA's "BOCA National Building Code."
5. Table 2306.1, "Fastening Schedule," in SBCCI's "Standard Building Code."
6. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's "International Residential Code for One- and Two-Family Dwellings."
7. Table 602.3(1), "Fastener Schedule for Structural Members," and Table 602.3(2), "Alternate Attachments," in ICC's "International One- and Two-Family Dwelling Code."

B. Coordinate sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that exclude exterior moisture.

C. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."

1. Comply with "Code Plus" installation provisions in guide referenced in paragraph above.

B. Fastening Methods: Fasten panels as indicated below:

1. Wall and Roof Sheathing:

a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Screw to cold-formed metal framing.

3.3 WEATHER-RESISTANT SHEATHING-PAPER INSTALLATION

A. General: Cover sheathing with weather-resistant sheathing paper as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.

2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap, unless otherwise indicated.

B. Building Paper: Apply horizontally with a 2-inch (50-mm) overlap and a 6-inch (150-mm) end lap; fasten to sheathing with galvanized staples or roofing nails.

C. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.

3.4 SHEATHING JOINT-AND-PENETRATION TREATMENT

A. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing board joints, and apply and trowel silicone emulsion sealant to embed tape in sealant. Apply sealant to exposed fasteners. Seal other penetrations and openings.
3. Apply sheathing tape to joints between foam-plastic sheathing panels and at items penetrating sheathing. Apply at upstanding flashing to overlap both flashing and sheathing.

3.5 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturers written instructions.

1. Lap seams and junctures with other materials at least 4 inches (100 mm), except that at flashing flanges of other construction, laps need not exceed flange width.
2. Lap flashing over weather-resistant building paper at bottom and sides of openings.
3. Lap weather-resistant building paper over flashing at heads of openings.
4. After flashing has been applied, roll surfaces with a hard rubber or metal roller.

3.6 PROTECTION

A. Paper-Surfaced Gypsum Sheathing: Protect sheathing by covering exposed exterior surface of sheathing with weather-resistant sheathing paper securely fastened to framing. Apply covering immediately after sheathing is installed.

END OF SECTION 061600

SECTION 073226

SYNTHETIC SLATE ROOF SYSTEM

PART 1 – GENERAL

1.01 DESCRIPTION

A. Furnish and install Synthetic Slate tile roofing system as specified in the Contract Documents and roof plan.

B. Furnish and install this Synthetic Slate tile roofing system in strict accordance with specifications and drawings approved by Manufacturer. Slate shall be by EcoStar of New Holland New York, or approved equal

C. Related Work

1. Metal flashing and securement of metal should be to industry standards (SMACNA) to prevent the metal from pulling free or buckling. All flashing metal shall be copper (see 3.03D).

1.02 QUALITY ASSURANCE

A. To qualify for a 50-year warranty, an authorized applicator must install a complete system.

B. There shall be no deviation made from this specification without written approval from Manufacturer prior to the start of the roofing project.

C. Upon completion of the installation, an inspection must be conducted by a Field Service Representative of manufacturer to ascertain that the roofing system has been installed according to Manufacturer's published specifications and details at time of bid. This inspection is not intended to be a final inspection for the benefit of the owner, but for the benefit of Manufacturer to determine whether a warranty shall be issued.

D. It is the authorized roofing applicator's responsibility to adhere to all applicable building codes (local and national) and to have or acquire the appropriate licenses and permits for the roofing system installation requirements and limitations in their local areas applicable at the time of the bid.

E. Specific testing requirements:

1. Class A Fire Resistance – UL 790 Test Standard

2. Class 4 Impact Resistance – UL 2218 Test Standard

3. Wind Driven Rain – PA100-95 Test Standard

4. Wind uplift – UL 1897 Test Standard

1.03 SUBMITTALS

A. Coordinate with roof manufacturer technical department PRIOR to beginning work.
   1. The “Manufacturer Pre-Project Survey Form” must be filled out completely and accurately to include any prior deviations approved from this specification, including a roof drawing showing all dimensions, all penetrations and roof slope.

B. When a Manufacturer warranty is desired, Manufacturer must be contacted PRIOR to project bid and installation. Information will be required for wind speeds and deviation from standard slope requirements.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials in original unopened packages.

B. Packages shall be labeled with manufacturer name, brand name and identification of various items.

C. Synthetic Slate tiles may not be installed if the tiles have been stored in temperatures lower than 45°F. If tiles have been stored in temperatures below 45°F, tiles must be brought back to a material temperature of 45°F. As the temperature rises, Synthetic Slate tiles will expand beyond the designated installation pattern if the product is installed while cold or frozen.

D. Store all materials in a dry protected area. Damaged materials must NOT be used. Installed materials found to be damaged shall be replaced at Authorized Applicator’s expense.

1.05 JOB CONDITIONS (CAUTIONS AND WARNINGS)

A. Contact the Manufacturer technical department for procedures when installing a Synthetic Slate tile roof system during temperatures lower than 45°F.

B. All existing roof materials MUST be removed prior to installation of the Synthetic Slate tile roof system.

C. Roofing surface must be free of ice, water, or snow prior to and during the roofing project.

PART 2 – PRODUCTS

2.01 GENERAL

A. All components of the Synthetic Slate roof system are to be products manufactured or supplied by Manufacturer LLC.

NOTE: Only products supplied by Manufacturer are included in the warranty unless

otherwise specified and approved in writing by Manufacturer LLC.

2.02 TILES

A. Synthetic Slate tiles are made of a thermoplastic polyolefin compound with appropriate colorants and UV stabilizers, at 10'' or 12" widths by 18" long, and with a tapered nominal thickness of 1/4". W eight shall be determined by the following acceptable tile exposures:

12"	10"
[x] 6"	[x] 6"

B. Synthetic Slate tile color selection by director's representative from a mix of manufacturer's standard colors to match the existing slate.

2.03 RELATED MATERIALS

A. Underlayment

1. Self-adhesive Ice and Water Shield –**entire roof** & follow roof manufacturer's requirements and the following;

   a. Lap end joints 6" and side joints 3.5".

   b. Apply continuous 36" wide sheet in valley centered over valley.

   c. Apply rows of 36" wide sheets along all eaves and rakes. Lap end joints 6" and side joints 3.5".

   d. Apply rows of 36" wide sheets along and around all dormers and roof protrusions. Lap end joints 6" and side joints 3.5".

   e. When applicable install as far up as it can be installed on any head walls or vertical walls a minimum of 12" where possible.

   f. Do not leave underlayment exposed to weather more than 30 days after beginning of installation.

   g. Installation of Ice and Water Shield at temperatures below 40° F may require nailing or priming to hold membrane in place while adhesion develops.

   h. Apply over complete deck, lapping a minimum of 4". Install two layers at dormer roofs.

   i. Refer to the installation instructions found in the Product Data section of the technical binder for fastening requirements. Do not leave exposed to weather more than 60 days after beginning of installation.

B. Fasteners

1. Fasteners shall be corrosive-resistant, plastic-capped roofing nails with a minimum plastic cap diameter of 1". Fasteners shall be 90° to the roof deck and shall not be under or over driven.

2. Tile Fasteners

   a. Manufacturer ring shank roofing nail with a 3/8" diameter head and a minimum of 1-1/2" long shank made from stainless steel. Nails can be supplied either as a hand-drive style or in coils for use in pneumatic tools. The Manufacturer ring shank roofing nail is required for fastening of all Manufacturer roof tiles.

PART 3 - EXECUTION

3.01 SUBSTRATE CRITERIA

A. The roof contractor is responsible for providing and determining that the substrate is suitable to receive the Synthetic Slate tile roof system and the authorized applicator should not proceed until all defects have been corrected. Owner stipulates that roof deck is in good shape.

B. Minimum slope of substrate for installation of Synthetic Slate roof systems shall be a minimum of 3/12 for 6" exposure installation and a minimum of 6/12 for 7" exposure installation. Contact the Manufacturer technical department for approval of applications on lower slopes or exceptions to this requirement.

3.02 SUBSTRATE PREPARATION

A. The building owner or owner's representative is responsible for ensuring that all wet or damaged substrate has been removed in a re-roofing application.

B. Existing roof material MUST be removed and a clean substrate free of foreign material be provided prior to the installation of the Synthetic Slate tile roof system. Synthetic Slate tiles may NOT be installed directly over any existing roof material or system.

3.03 INSTALLATION

A. Flashing & Sheet Metal – Install sheet metal and flashing metal in all valleys and where required.
Manufacturer recommends a V-type, W -type, or Double W-type metal valley flashing be used at all valleys.

B. Existing metal edging at all eaves and roof edges to remain

C. All metal work be made from 16 oz. copper.

D. Be aware that staining may occur where runoff from copper metal work comes into contact with the Manufacturer tiles. (Example; ridges or cupolas.)

E. Underlayment

1. Self-adhesive Ice and Water Shield – follow roof manufacturer's requirements and the following:

   a. Lap end joints 6" and side joints 3.5".

   b. Apply continuous 36" wide sheet in valley centered over valley.

   c. Apply rows of 36" wide sheets along all eaves and rakes. Lap end joints 6" and side joints 3.5".

   d. Apply rows of 36" wide sheets along and around all dormers and roof protrusions. Lap end joints 6" and side joints 3.5".

   e. When applicable install as far up as it can be installed on any head walls or vertical walls a minimum of 12" where possible.

   f. Do not leave Surface (100) exposed to weather more than 30 days after beginning of installation.

   g. Installation of Ice and Water Shield at temperatures below 40° F may require nailing or priming to hold membrane in place while adhesion develops.

   h. Apply over complete deck, lapping a minimum of 4". Install two layers at dormer roofs.

   i. Refer t o t he installation instructions found in the Product Data section of the technical binder for fastening requirements. Do not leave exposed to weather more than 60 days after beginning of installation.

F. Synthetic Slate Tile Installation

1. After installing underlayment and before installing the Synthetic Slate tiles, clean the surface of debris and dirt.

2. Care must be taken to place tiles so shade variations and contrasting colors are evenly distributed over the entire roof area. Shade variations will occur differently from pallet to pallet and within individual pallets. Tiles between bundles and pallets MUST be blended to ensure even distribution of shade variations. Shade "mapping" or "blotching" in appearance is not acceptable and the Manufacturer authorized applicator will be required to correct. It is recommended that work not begin until all Manufacturer materials have been delivered to the job site so that all the material may be blended together. Periodic ground inspections should be

conducted to ensure a random shade pattern to the installation. Please contact Manufacturer's technical department for correct blending procedures.

3. Minimum Fastening – No less than 2 Manufacturer ring shank fasteners per tile shall be used with a minimum length of 1-1/2". Fasteners should be installed at the designated "nail here" marks on the tile. Failure to fasten the tile at these locations may result in a "lifted" tile that will require removal and replacement.

4. CAUTION: When using a pneumatic nailer care should be taken to ensure that nails are not over driven causing the tiles to curl upward. If tiles have been installed with over driven nails causing the ends of the tile to curve upward, tiles will never lay flat. Overdriven tiles must be removed and re-nailed properly. Never hold tiles from behind while nailing, as this will cause an upward curl of the tile.

5. Do not install tiles against each other. A minimum gap of 3/8" must be maintained between installed tiles. A minimum 3/8" gap must be maintained between installed tiles and any sidewalls or roof protrusion.

6. Beginning at the eave, install a starter row of Synthetic Slate tiles gapped a minimum of 3/8" between tiles and any protrusions while achieving a 3/4" overhang. Fasten with two Manufacturer ring shank fasteners per tile (in location shown on tiles). This layer of tiles will become the starter row. The final tile at roof edges or penetrations must be a minimum of 3" wide. This may involve cutting the Manufacturer tile to fit. To cut the Manufacturer tile to correct width simply score the back of the tile with a straight edge and utility knife and snap tile at that score. Install first course of tiles in the same manner as the starter row with the exception of the second layer having a 1/2 tile offset to the starter row. The first course of tiles should be installed flush with the starter row with no exposure.

7. After the initial starter and first row of tiles has been installed, it is recommended that a chalk line be placed parallel to the roof edge running perpendicular to the first row of tiles. This chalk line will ensure that the tiles stay true and plumb to the roof edge throughout installation. Never use red chalk, as this will permanently stain the Manufacturer roof tiles.

8. Continue installing tile courses up the roof slope now achieving the correct chosen exposure. It is recommended that chalk lines be placed horizontally up the roof slope for every tile course. This will ensure that each course is installed parallel with the roof eave.

9. It is the responsibility of the Authorized Applicator to ensure that each Synthetic Slate tile has been flexed to provide a downward curve prior to tile fastening. Do not install tiles with an upward curve.

10. Valley Areas – Either an open or closed valley design may be used.

    a. With an open valley design leave a minimum of 2" on each side of

the center of the valley exposed and uncovered by the roof tiles. A V-Style, W -Style, or Double W - Style valley metal may be used.

b. With a closed valley design cut the tiles in a straight line to fit no closer than 3/8"
against tile of adjoining roof slope.

11. A minimum 2.5" stainless steel ring shank, hand-driven Manufacturer fastener should be used on a ventilated hip/ridge to fasten the hip/ridge tile to the deck. A minimum 2" stainless steel, hand- driven Manufacturer fastener should be used on an unventilated hip/ridge to fasten the hip/ridge tile to the deck. Place fasteners in the location marked on the tile. Synthetic Slate Hip/Ridge tile must be installed with 6" exposure.

12. Install Synthetic Slate – Hip & Ridge tiles at all hip locations. Manufacturer recommends a chalk line be snapped up the hip line to ensure a straight application up the roof slope. Synthetic Hip & Ridge tiles are always installed at a 6" exposure. See detail 3, DRWG A-2.

13. Care must be taken to minimize foot traffic over completed areas of the roof. Synthetic Slate tiles will show mud and dirt causing appearance problems. The removal of dirt and debris is the responsibility of the applicator. Never use chemical cleaning agents not approved by Manufacturer to wash a Manufacturer roof assembly.

14. Synthetic Slate tiles can be slippery when wet; caution should be exhibited with early morning dew and after rain. Manufacturer strongly recommends the use of toe boards and OSHA approved harnesses and safety equipment at all times.

15. Upon completion of the roof system installation, inspect and remove all debris from roof. G. Phased Roofing – The weathering process of the Manufacturer tiles will begin immediately upon installation and exposure to the elements. Therefore, every effort should be made to ensure the Manufacturer roof assembly is installed at a continuous rate to completion. Lengthy delays in installation may result in appearance differences when installation is resumed and tiles that have not been exposed to the elements are installed adjacent to tiles that have been on the roof for an extended period of time.

END OF SECTION

SECTION 076200

FLASHING AND TRIM

PART 1 GENERAL

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Synthetic Slate Roof System Section 07314

1.03 REFERENCES

A. SMACNA - Sheet Metal and Air Conditioning Contractors National Association.

B. CDA - Copper Development Association Inc.

C. ASTM - American Society for Testing and Materials.

D. FS - Federal Specifications.

1.04 SYSTEM DESCRIPTION

A. Metal flashings, trim, and related accessories that form terminations and waterproof connections.

1.05 SUBMITTALS

A. Samples:
   1. Materials for Flashings: One 6-inch sq piece, for each type material specified.

1.06 QUALITY ASSURANCE

A. Except as otherwise shown or specified, comply with applicable recommendations, details, and standards of CDA, and SMACNA.

B. Manufacturer's Recommendations: For factory fabricated items, follow the manufacturer's recommendations and installation instructions unless specifically shown or specified otherwise.

1.07 PROJECT CONDITIONS

A. Do not execute the Work of this Section unless the Director's Representative is present, or unless he directs that the Work be performed during his absence.

B. Make the roof and all uncompleted flashings watertight at the end of each workday.

PART 2 PRODUCTS

2.01 MATERIALS FOR FLASHING FABRICATION

A. Copper: 16 oz. sheet.

2.02 FASTENERS

A. Nails: “Stronghold” type large flat head roofing nail.
   1. For copper: copper nails.

2.03 MISCELLANEOUS MATERIALS

A. Solder: Composition of block tin/pig lead of proportion recommended by the metal manufacturer.

B. Flux: Paste or acid type as recommended by the metal manufacturer.

C. Bituminous Coating: FS TT-C-494.

D. Type 2 Sealant: Acrylic Sealant, FS TT-S-00230.

E. Type 3 Sealant: One-part butyl rubber sealant; Pecora BC-158, PTI 707, or Woodmont Chem-Calk 300.

F. Type 4 Sealant: One-part high temperature silicone; Dow Corning Silastic 736 RTV or General Electric RTV 106.

G. Thru Wall Flashing Joint Sealant: Trowel grade asphalt roof cement.

2.04 FABRICATION

A. Where practicable, form and fabricate sheet metal Work in the factory or shop. Produce bends and profiles accurately to the indicated shapes. Where not indicated or specified, follow the applicable requirements of the reference standards listed in PART 1.

B. Copper for all flashing. 16 oz.

C. Flashing Pipe thru-Roof:
   1. Copper: 16 oz.

PART 3 EXECUTION

3.01 EXAMINATION

A. Coordinate the Work of this Section with other Work for the correct sequencing of items that make up the entire system of weatherproofing or waterproofing.

3.02 PREPARATION

A. Do not install the Work of this Section unless all necessary nailers, blocking and other supporting components have been provided.

B. Do not install the Work of this Section unless all substrates are clean and dry.

3.03 INSTALLATION

A. Isolation: Separate dissimilar metals from each other with bituminous coating.

B. Installing Cap Flashing:
   1. Form and install the cap to provide a spring tight fit against the base flashing. Lap all end joints and base flashing a minimum of 3 inches. Extend the cap continuously around corners or provide lock seams.
   2. Cap Flashing for Installation In Reglets:
      a. Extend the built-in portion of the cap a min of 3/4-inch into the reglet. Form the edge of the built-in portion with a 1/4-inch hook dam.
      b. Secure the cap with lead wedges 8 inches oc. Fill joint completely with Type 2 sealant and tool to a slightly concave surface.

C. Installing Base Flashing:
   1. Form the base flashing into lengths not exceeding 8 ft long.
   2. Extend the vertical portion of the base flashing a min of 3 inches up behind the cap flashing.
   3. Extend the horizontal portion of the base flashing onto the roof surface a min of 4 inches and terminate in a 1/2-inch folded edge.
   4. Lap ends a min of 6 inches. Apply type 3 sealant between the mating surfaces of each length of flashing.
   5. Secure the flashing to the roof surfaces with 2-inch-wide cleats (same material) hooked over the folded edge and nailed to the roof deck. Install cleats 8 inches oc.

D. Installing Pipe Flashing:
   1. Extend the base flashing a minimum of 5 inches onto the roof surface. Terminate the bottom exposed edge with a 1/2-inch folded seam. Solder the base flashing to the tube flashing.

   2. Install the flashing after the course of shingles immediately below the pipe is installed so that the bottom side of the flashing is over the shingle and the sides and top are beneath the shingles. Nail the top and sides of the flashing only.
   3. Provide a cap flashing fabricated to slip over the tube flashing and the pipe. Lap the tube flashing a minimum of 3 inches and the pipe a minimum of one inch. Solder all seams.

END OF SECTION

SECTION 079200

EXTERIOR SEALANTS

PART 1 GENERAL

1.01 GENERAL PROVISIONS

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

1.01 WORK INCLUDED

A. Caulk and seal joints as indicated on the Drawings and as specified. Include, but do not limit to:

1. Sealing of joints in exterior construction.
2. All other exterior sealing called for, or reasonably inferred from the Drawings, and as required to provide weathertight conditions in exterior assemblies.
3. Control and expansion joints in pavements and slabs.
4. Isolation and contraction joints in cast-in-place concrete slabs.
5. Other joints as indicated.

1.02 RELATED WORK

B. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033001, CAST-IN-PLACE CONCRETE - SITEWORK.
2. Section 321313, PORTLAND CEMENT CONCRETE PAVING

1.02 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Association of State Highway and Transportation Officials (AASHTO):

M 220	Preformed Elastomeric Compression Joint Seals for Concrete

2. American Society for Testing and Materials (ASTM):

C 719	Adhesion and Cohesion of Elastomeric Joint Sealants under Cyclic Movement
C 790	Use of Latex Sealing Compounds
C 834	Latex Sealing Compounds
C 920	Elastomeric Joint Sealants
C 962	Use of Elastomeric Joint Sealants
C 1248	Staining of Porous Substrate by Joint Sealants

C 1521 Adhesion of Installed Weatherproofing Sealant Joints

D 412 Test Methods for Rubber Properties in Tension

D 624 Test Method for Rubber Property - Tear Resistance

D 2628 Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements

3. Federal Specifications (Fed. Spec.):

TT-S-00227 Sealing Compound: Elastomeric Type, Multi- Component (For Calking, Sealing, and Glazing in Buildings and Other Structures)

TT-S-001543A Sealing Compound: Silicone Rubber Base (For Caulking, Sealing, and Glazing in Buildings and Other Structures)

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's printed product data, specifications, MSDS Sheets, standard details, installation instructions, use limitations and recommendations for each sealant material used. Provide certifications that sealant materials comply with specified requirements.

B. Initial Selection Samples: Submit samples manufacturer's color charts showing complete range of colors, textures, and finishes available for each material used.

C. Verification Samples: Submit actual representative samples of each sealant material that is to be exposed in the completed work. Show full color ranges and finish variations expected. Provide sealant samples having minimum size of 4 in. long.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.

E. SWRI Validation Certificate: For each elastomeric sealant specified to be validated by SWRI's Sealant Validation Program.

F. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

G. Test Reports: Provide certified reports for all specified tests.

1.04 COMPATIBILITY

A. All trades using sealants at the exterior of the building to coordinate and use the same sealant to avoid problems with compatibility.

B. Provide sealant and sealant joint backing materials suitable for the use intended and compatible with the materials with which they will be in contact. Compatibility of sealant and accessories shall be verified by the sealant manufacturer.

1.05 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

1.06 QUALITY ASSURANCE:

A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.

1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

B. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the [Notice to Proceed with] [commencement of] the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
3. Test elastomeric joint sealants according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
4. Test other joint sealants for compliance with requirements indicated by referencing standard specifications and test methods.

C. Preconstruction Field-Adhesion Testing: Before installing elastomeric sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Director’s Representative.
2. Conduct field tests for each application indicated below:
    a. Each type of elastomeric sealant and joint substrate indicated.
    b. Each type of nonelastomeric sealant and joint substrate indicated.
3. Notify Director’s Representative seven days in advance of dates and times when test joints will be erected.
    a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1521.
        1. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
4. Report whether sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.

5. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

D. Stain Testing: Provide testing of joint sealant material at stone masonry joints to determine possibility of staining stone material. Test shall be conducted in accordance with ASTM C1248. If test results indicate staining of stone materials as a result of joint sealant material, Contractor shall use primer at joints or take other measures as recommended by joint sealant manufacturer and testing agency to prevent such staining.

E. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution. Obtain Director's Representative's acceptance of visual qualities. Protect and maintain accepted mock-ups throughout the remainder of the work of this section to serve as criteria for acceptance of the work.

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified in the respective Section or by reference to this Section.

F. Source: For each sealant material type required for the work of this section, provide primary materials which are the product of one manufacturer. Provide secondary or accessory materials which are acceptable to the manufacturers of the primary materials.

G. Installer: A firm with a minimum of five years' experience in type of work required by this Section and which is acceptable to the manufacturers of the primary materials.

1.07 PROJECT CONDITIONS

A. Weather: Perform work of this Section only when existing or forecasted weather conditions are within the limits established by manufacturers of the materials and products used.

B. Substrates: Proceed with work only when substrate construction and penetration work is complete

1.08 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Materials under this Section shall be delivered to, and stored at, the job site in unbroken factory sealed containers with labels intact.

B. Handle all materials to prevent damage.

C. Keep all materials dry while they are transported, stored, and delivered. Deliver materials in manufacturer' unbroken containers. Store all materials on pallets and cover with waterproof canvas tarpaulins completely, top to bottom. Polyethylene covers are not acceptable. Store materials in a secure area designated by the Owner with adequate tie- downs against wind gusts.

D. Materials shall be marked with the date of manufacture and shelf life. Do not use products beyond the expiration of their shelf life. Store flammable materials in a cool, dry, protected area, away from sparks and open flames.

E. Repair all damage as a result of the work of this Section to its condition at the start of work or, if such cannot be determined, to its original condition. Clean all stains by approved means.

F. Protect the work from damage such as impact, marring of the surfaces, and other damage.

G. Replace materials damaged during handling or storage. Remove damaged materials from the premises immediately.

1.09 WARRANTY

A. Furnish joint sealant manufacturer's written single-source performance warranty that joint sealant work will be free of defects related to workmanship or material deficiency for five years from date of Substantial Completion of the Project.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Before installation check each sealant for compatibility with adjacent materials and surfaces and with indicated exposures. Select sealers which are recommended by manufacturer for each application indicated. Where exposed to pedestrian or vehicular traffic, provide sealants which are non-tracking and are strong enough to withstand the traffic without damage.

B. Provide colors as selected by Director’s Representative from manufacturer's standard and special (Tremco Fastpak) colors. Where specifically requested, provide custom color matches.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Director’s Representative from manufacturer's full range

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

2.04 HIGH PERFORMANCE SILICONE SEALANT

A. Provide a high performance, one component, neutral cure, 100% silicone sealant, similar to Dow Corning Contractors Concrete Sealant, manufactured by Dow Corning Corporation; LATASIL, manufactured by Laticrete International, Inc., One LATICRETE Park North, Bethany, CT 06524-3423 USA; Tel +1.203.393.0010; Toll Free 1.800.243.4788; Fax +1.203.393.1684; www.laticrete.com, or approved equal.

1. Primer for all joints to receive silicone sealant shall be one component primer designed to increase adhesion to various substrates and approved by sealant manufacturer.

B. Extent: Provide high performance silicone sealant for joints at all stone, stone masonry and masonry veneer work.

2.05 SELF-LEVELING POLYURETHANE SEALANT

A. Provide two or more part, self-leveling, polyurethane based elastomeric sealant, complying with ASTM C 920, Type M, Grade P, Class 25 Use T, Fed. Spec. TT-S-00227E Type 1 Class A, having Shore A hardness of not less than 30 when tested according to ASTM C920, cured modulus of elasticity at 100% elongation of not more than 150 psi when tested according to ASTM D 412, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D 624.

B. Where joint surfaces contain bituminous materials, provide modified sealants which are compatible with bituminous materials encountered.

C. Provide one of the following products, or approved equal, that meet or exceed specified requirements:

1. Pecora Urexpan NR-200.
2. Mameco Vulkem 245 or 255.
3. Sika 2C, S/L.
4. Sonneborn Sonolastic SL-1.
5. Tremco THC 901.

D. Extent: Provide self-leveling polyurethane sealant for paving joints not indicated to be sealed with another type of sealant

2.06 NON-SAG POLYURETHANE SEALANT

A. Provide multi-part, non-sag, polyurethane based elastomeric sealant, complying with ASTM C 920 Type M, Grade NS, Class 25, Fed. Spec. TT-S-00227E Class A, having Shore A hardness of 20 to 30, cured modulus of elasticity at 100% elongation of not more than 75 psi, and tear resistance of not less than 50 lbs./inch when tested according to ASTM D 624.

B. Provide one of the following products, or approved equal, that meet or exceed specified requirements:

1. Mameco International Vulkem 227
2. Harry S. Peterson Co. Iso-Flex 2000
3. Sika Sikaflex 2C N/S.
4. Sonneborn Sonolastic NP 2.
5. Tremco Dymeric

C. Where joint requires 50% movement capabilities, provide Tremco Dymeric Plus, or equal product approved by Director’s Representative.

D. Extent: Provide non-sag polyurethane sealant for all other joints not indicated to be sealed with another type of sealant.

2.07 PREFORMED JOINT SEALER

A. Preformed Resilient Joint Sealer: Preformed Resilient Joint Sealer for use at building expansion joints in exterior concrete and masonry walls where specifically called for on Drawings shall be preformed, resilient, extruded polychlorophrene elastomeric joint sealer, conforming to ASTM D 2628 and AASHTO M 220 of indicated configuration(s), in continuous lengths, set in manufacturer's recommended primer-lubricating-adhesive consisting of moisture curing polyurethane and aromatic hydrocarbon solvent mixture (73% solid by weight) concrete gray color, similar to one of the following, or approved equal:

1. D.S. Brown Co.
2. Watson-Bowman & Acme Corp.

2.08 PREFORMED, PRECOMPRESSED, IMPREGNATED FOAM SEALANT

A. Provide manufacturer's standard preformed, precompressed, impregnated open-cell foam sealant manufactured from high-density urethane foam impregnated with a nondrying, water-repellant agent; factory-produced in precompressed sizes in roll or stick form to fit joint widths indicated. Provide foam sealant permanently elastic, mildew-resistant, nonmigratory, nonstaining, compatible with substrates, and complying with the following requirements:

1. Impregnating Agent: Manufacturer's standard.
2. Density: 8 - 10 lb./cu. ft.
3. Backing: Manufacturer's standard pressure sensitive adhesive, factory applied to one side, with protective wrapping.

B. Provide one of the following products, or Director’s Representative approved equal:

1. Emseal Greyflex; Emseal Corp.
2. Will-Seal 150; Wil-Seal Construction Foams Div., Illbruck.
3. York-Seal 100; York Manufacturing, Inc.

2.09 MISCELLANEOUS MATERIALS

A. Primer: Provide primer recommended by sealant manufacturer for surfaces to be adhered to.

B. Bond Breaker Tape: Provide polyethylene or other plastic tape recommended by sealant manufacturer to prevent three-sided adhesion.

C. Backer Rod: Provide closed-cell nongassing compressible rod of durable nonabsorptive material recommended by sealant manufacturer for compatibility with sealant. The diameter of the rod is to be approximately 25% in excess of the joint width. Surface skin of the rod shall be continuous and unbroken and of sufficient thickness to preclude outgassing and formation of voids in the overlying sealant. Open-cell backup rod is not permitted Provide products of one of the following manufacturers:

1. Backer Rod Manufacturing and Supply Co.
2. Dow Chemical Co.
3. W. R. Meadows, Inc.
4. Williams Products, Inc.
5. Woodmont Products, Inc.

D. Joint backing for general use at joints in horizontal surfaces shall consist of two rows of butyl rubber or neoprene foam rod in contact with one another, and each compressed to approximately 2/3 original width when in place.

E. Provide miscellaneous materials of type that will not bleed through sealant, discolor surface, or produce other deleterious effects. Select size to provide compression to approximately 2/3 original width when in place. Provide backing material profile concave to the rear of the sealant and equipped with a bond-breaking film.

PART 3 EXECUTION

3.01 INSPECTION

A. The Installer shall examine substrates and conditions under which this work is to be performed and notify Contractor, in writing, of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions are corrected. Beginning of sealant work means Installer's acceptance of joint surfaces and conditions.

3.02 PREPARATION

A. Strictly comply with manufacturers' instructions and recommendations, except where more restrictive requirements are specified in this Section.

B. Clean joint surfaces immediately before installation of sealants, primers, tapes and fillers. Remove substances which could interfere with bond. Etch or roughen joint surfaces to improve bond. Surfaces which have been given protective coatings and those that contain oil or grease shall be thoroughly cleaned with xylol or MEK solvent, with due precautions taken to minimize hazards.

C. Unless otherwise indicated, use of sealants shall conform to the following: ASTM C 790 for latex sealants and ASTM C 962 for other sealants.

D. Tape or mask adjoining surfaces to prevent spillage and migration problems.

E. Prime surfaces as recommended by sealant manufacturer.

3.03 INSTALLATION

A. Schedule work as long as possible after completion of concrete work and finished stone work.

B. Provide backer rods for liquid sealants except where specifically recommended against by sealant manufacturers.

C. Prevent three-sided adhesion by use of bond breaker tapes or backer rods.

D. Force sealant into joints to provide uniform, dense, continuous ribbons free from gaps and air pockets. Completely wet both joint surfaces equally on opposite sides.

E. Except in hot weather, make sealant surface slightly concave. Install sealants so that compressed sealants do not protrude from joints. Dry tool sealants to form a smooth dense surface. At horizontal joints form a slight cove to prevent trapping water.

F. Provide sealants to depths indicated, or if not indicated, follow manufacturer's recommendations. For joints up to 3/8 in. width, depth of joint shall not exceed 1/2 in.; for joints larger than 1/2 in. width, depth of joint shall not exceed 5/8 in.

G. Apply sealant only to clean, dry, primed surfaces at ambient temperatures above 40°F. Seal joints within 10 hours of primer application.

H. Fill all joints solidly and continuously with sealant neatly applied with a standard caulking gun in a continuous motion, using a slight pressure. “Push” the sealant bead ahead of the nozzle; do not “drag” the nozzle.

I. Within 5 min. of sealant application and before skin develops on sealant, dry-tool the joint surface with a concave tool to ensure intimate contact with substrate and to eliminate air bubbles. Do not use any liquid for tooling. Provide a smooth, uniform finished surface.

J. Remove masking within 10 min. of tooling. Avoid contaminating adjacent surfaces with excess sealant. Remove all traces of smears and droppings on metal or glass surfaces promptly, using a solvent that is recommended by the sealant manufacturer and that will not damage or discolor the building surfaces. Remove smears and droppings on porous surfaces by mechanical means after the initial cure of the sealant.

3.04 EXTENT OF SEALANT WORK

A. General Extent: Seal joints indicated, and all interior and exterior joints, seams, and intersections between dissimilar materials. Provide elastomeric sealant installation with backer rod in all interior and exterior control joints.

B. Exterior Sealing: Without limitation, the work of this Section includes sealing the following:

1. Masonry to masonry joints.
2. Masonry to masonry joints immersed intermittently or continuously in water.
3. Masonry to other exterior materials, including concrete, precast concrete, metal, and wood.
4. Precast to precast joints.
5. Metal to metal joints.
6. Wood to wood and wood to metal joints.
7. Concrete to concrete joints.
8. Joints and cracks in paving and walks.
9. Joints and cracks in vertical walls.
10. Joint fillers for all joints.

3.05 CURING

A. Cure sealants in strict compliance with manufacturers' instructions and recommendations to obtain highest quality surface and maximum adhesion. Make every effort to minimize accelerated aging effects and increase in modulus of elasticity.

3.06 CLEANING AND PROTECTION

A. Remove smears from adjacent surfaces immediately, as the work progresses. Exercise particular care to prevent smearing or staining of surrounding surfaces which will be exposed in the finished work, and repair any damage done to same as result of this work without additional cost to Owner.

B. Remove and replace work that is damaged or deteriorated.

C. Clean adjacent surfaces using materials and methods recommended by sealant manufacturer. Remove and replace work that cannot be successfully cleaned.

D. Provide temporary protection to ensure work being without damage or deterioration at time of final acceptance. Remove protection immediately before final acceptance.

END OF SECTION

SECTION 088100

EXTERIOR GLASS – ALTERNATE 1

PART 1 GENERAL

1.00 GENERAL PROVISIONS

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

A. This Section includes, but is not limited to, the following:

1. Laminated glass units.
2. Glazing materials and accessories.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033001, Cast-in-Place Concrete - Sitework

1.03 SUBMITTALS

A. Product Data: Submit manufacturer's specifications and installation instructions for each type of glass required.

B. Samples:

1. Submit minimum 300 mm (12 inch) square samples of each type of glass (except clear single lite glass).
2. Samples shall be typical production run quality and, as applicable, shall be complete with required low emissivity coatings, laminating films, and primary and secondary edge seals.

C. Certificates:

1. Submit certificate from glass manufacturer stating that manufacturer has reviewed glazing details including use of sealants and gaskets and each product provided is recommended for application indicated, and that materials are compatible and will adhere to specified finish.
2. Submit certificate from glass manufacturer stating that manufacturer has reviewed application of heat absorbing or reflective glass for effects of partial or full shading (including locations and types of indicated interior window treatment) under expected service temperature ranges and that resulting thermal stresses will not reduce "Glass Statistical Factor" below 2.5.
3. Submit certificate for glass materials at "Hazardous Locations" showing compliance with requirements of CPSC 16CFR, Part 1201.
4. Submit certificate stating that glass units can withstand design loads.

D. Qualification Data: Submit manufacturer and installer qualifications verifying years of experience; include list of completed projects having similar scope of work identified by name, location, date, reference names and phone numbers.

E. Maintenance Data:

1. Submit cleaning and maintenance data for materials provided.
2. Include copy of submittal in Project information manual.

F. Warranties: Submit signed and dated warranties.

1.04 SYSTEM REQUIREMENTS

A. Design Requirements:

1. Glass thicknesses when indicated are for convenience of detailing only and are to be determined by Contractor or glass manufacturer as required to fulfill performance requirements.
2. Glazing channel dimensions indicated are intended to provide necessary minimum bite on glass, minimum edge clearances and adequate sealant and/or gasket thickness within required tolerances.
3. Coordinate glazing systems with glazing channels to assure proper installation of systems.

B. Performance Requirements:

1. Glass Statistical Factor (Safety Factor):
   a. Provide glass of sufficient thicknesses that probability of breakage at "Design Wind Pressure" will not exceed 8 lites per 1000 lites (2.5 SF) at 60 second wind load.
   b. Provide glass manufacturer's data, on request, substantiating glass breakage data if such data is not otherwise available as manufacturer's published data.
2. Compatibility and adhesion: Provide glazing sealants, gaskets, and glazing accessories which are compatible with each other and with glass and glass framing members, and which will adhere to joint surfaces.
3. Provide watertight and airtight installation of glass.
4. Each installation must withstand specified performance requirements including normal temperature changes, wind loading and impact loading, without failure.

C. Interface with Other Systems: Provide primary and secondary seals on insulating units that are compatible with sealant used for structural glazing.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Not less than 5 years documented successful experience in installation of work similar to Work of this Project, licensed or approved by glass manufacturer.

B. Single Source Responsibility:

1. Provide glass and glazing materials from one source for each type of glass.
2. Use same glazing material in each joint system unless material manufacturer recommends otherwise.

C. Manufacturer Qualifications:

1. Not less than 5 years documented successful experience in production of work similar to Work of this Project, with sufficient capacity to supply glass in a timely fashion.
2. Manufacturer of insulating glass units shall be a member of IGMA (Insulating Glass Manufacturers Alliance).

D. Regulatory Requirements:

1. Comply with applicable requirements of authorities having jurisdiction over Project.
2. Safety glazing requirements:
    a. Provide glass and glazing at "Hazardous Locations" complying with requirements of CPSC 16CFR, Part 1201, Consumer Product Safety Commission Standard on Architectural Glazing Materials, including required tests and labeling.
    b. Permanently identify each lite of safety glazing material with a listing mark as required by Code, visible after installation).

E. Reference Standards: Unless otherwise required to comply with regulatory requirements or otherwise recommended by fabricator to fulfill performance requirements, comply with the following:

1. AAMA "TIR-A Glazing Guidelines".
2. GANA "Glazing Manual".
3. IGMA TM-3000 "Glazing Guidelines for Sealed Insulating Glass Units".

1.06 PRE-INSTALLATION CONFERENCE

A. Prior to commencing Work, at Contractor's direction, meet at site and review installation procedures and coordination with other Work.

B. Attendees: Glass manufacturer's representative, glazier and fabricator of framing or other supporting structure receiving glass.

C. Agenda:

1. Review glazing procedure, application of glazing materials and installation of removable stops.
2. Evaluate suitability of specified compounds and sealants for anticipated weather conditions.
3. Review coordination with other Work.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver glazing materials in manufacturer's unopened packaging.

B. Glass shall bear manufacturer's labels indicating type and quality. Labels shall be left on glass until final cleaning, unless otherwise directed by Director’s Representative and Owner.

C. Store in accordance with manufacturer's recommendations.

D. Provide cushions at glass edges to prevent damage during handling or storage.

1.08 PROJECT CONDITIONS

A. Environmental Conditions:

1. Ensure that conditions of temperature, humidity and precipitation are as recommended by glass manufacturer.
2. Do not proceed with glazing when ambient or substrate temperature conditions are below 40 degrees F.

B. Install glazing sealants only when temperatures are in middle third of manufacturer's

recommended installation temperature range.

1. Do not perform any glazing Work when framing members are wet or frosted.

1.09 WARRANTY

A. Provide written 5-year warranties, made out to Trailside Museums and Zoo and signed by glass manufacturer agreeing to furnish replacements for the following:

1. In manufacturer's warranties, "initial purchaser" shall refer to Trailside Museums and Zoo.
2. Insulating glass units which have failed hermetic seal, fogging, reflective or low emissivity coating defects, breakage due to edge flaws (such as chips or gouges) or migration of edge spacers.
3. Laminated glass units which show evidence of delamination, deterioration of laminating films, loss of transparency or other forms of deterioration including edge separation due to defective materials or lamination, or breakage due to edge flaws (such as chips or gouges).
4. Coated glass which show evidence of peeling, cracking or deterioration of coating or breakage due to edge flaws (such as chips or gouges).
5. Glass units with latent visual defects.

PART 2 PRODUCTS

2.01 GLASS MATERIALS

A. Fully Tempered Glass:

1. ASTM C1048, Kind FT, of color and type indicated.
2. Provide fully tempered glass certified by SGCC or other recognized certification agency, acceptable to authorities having jurisdiction, as complying with requirements of CPSC 16CFR, Part 1201 for Category II materials.
3. Temper glass to increase flexural strength 4-5 times strength before treatment.
4. Treat glass in horizontal batch type reciprocating furnace, unless otherwise recommended by fabricator to fulfill performance requirements.
5. Make roller distortion parallel to horizontal dimension of installed glass.
6. Wherever possible, locate tong marks along edge which will be concealed in glazing system.
7. Permanently identify each unit of tempered glass with a listing mark as required by Code, visible after installation.
8. Locations: Provide as indicated and as required to comply with referenced standards.

B. Laminated Glass Units (LGU):

1. Provide laminated glass units certified by SGCC or other recognized certification agency, acceptable to authorities having jurisdiction, as complying with requirements of CPSC 16CFR, Part 1201 for Category II materials.
2. Provide laminated glass complying with requirements of ASTM C1172.
3. Adhesive laminating film:
    a. Material: Polyvinyl butyral plastic sheet.
    b. Thicknesses: As specified below.
    c. Color: Clear.
4. Fabrication:
    a. Laminate units at factory using manufacturer's standard heat-plus-pressure process.
    b. Exclude dirt and other foreign materials from lamination.
    c. Eliminate voids and delaminated surfaces from Work.

d. Cut units to proper size at factory. Do not cut laminated glass at Project site.
e. Cut and treat edges in accordance with glass manufacturer's recommendations.
f. Arrange each course of laminate in order specified and label exterior (or interior) face of each completed unit.

5. LGU schedule: refer to Construction Drawings

2.02 GLAZING MATERIALS

A. General:

1. Comply with manufacturer's recommendation for selection of hardness, depending on location of application, conditions at time of installation and performance requirements indicated.
2. Provide materials, and variations or modifications that are compatible with surfaces contacted in installation.
3. Color: Provide colors selected by Owner from manufacturer's standard colors.

B. Silicone Glazing (Weatherseal) Sealant:

1. Medium-modulus, neutral-curing silicone sealant; complying with ASTM C920, Type M or S, Grade NS, Class 25.
2. Color: Clear colorless.
3. Acceptable products and manufacturers:
   a. 790 or 795 by Dow Corning Corp.
   b. SilGlaze II by General Electric Co.
   c. 864 or 890 by Pecora.
   d. Spectrem 2 by Tremco.
   e. Or Zoo New England approved equal.

C. Butyl Rubber Glazing Tape:

1. Partly-vulcanized, self-adhesive, non-staining, elastomeric tape, 100% solids; complying with AAMA 800.
2. Provide with or without spacer rod, as recommended by tape and glass manufacturers to suit applications indicated.

D. Polyurethane Foam Glazing Tape:

1. High-density, closed-cell, flexible, non-extruding tape, adhesive backed one side only; recommended by manufacturer for exterior applications with nominal pressure in glazing channel.
2. Acceptable products: As recommended by manufacturer suitable for conditions of application and use.

E. Molded Resilient Neoprene Gaskets: Continuous extruded neoprene gaskets complying with applicable ASTM standards for physical properties including durometer hardness and tensile strength recommended by framing manufacturer and tested to demonstrate conformance with Contract Documents.

F. Glazing Accessories:

1. Provide materials with proven record of compatibility with surfaces and other materials contacted in installation.
2. Setting blocks: Neoprene or silicone, 70-90 Shore A durometer hardness.
3. Spacers: Neoprene or silicone, 40-50 Shore A durometer hardness, adhesive backed one face only.

4. Corner blocks: Closed cell neoprene wedge blocks designed to prevent lateral displacement of glass, as recommended by manufacturer and GANA Glazing Manual.
5. Cleaners, primers, and sealers: As recommended by sealant or gasket manufacturer.

2.03 FABRICATION

A. Cutting:

1. Obtain sizes from Shop Drawings or by field measurement.
2. Cut glass to fit openings with minimum edge clearances and bite on glass recommended by glass manufacturer. Do not nip glass edges.
3. Do not cut glass in field.
4. Edges:
   a. Concealed: Wheel cut or sawed and seamed.
   b. Exposed: Square edge; ground smooth and polished.
5. Provide required openings in tempered glass before heat-treating. Do not cut, seam, nip or abrade such glass after heat-treating.
6. When glass is pre-cut to sizes obtained from Shop Drawings, take field measurements of openings before glazing to verify adequate bite of glass and minimum edge clearance.
7. If openings do not comply with tolerances for which pre-cut glass was sized, use new glass specially cut to fit such openings.

PART 3 EXECUTION

3.00 EXAMINATION

A. Examine substrates, including framing and glazing channels, and adjoining construction, and conditions under which Work is to be installed. Do not proceed with Work until unsatisfactory conditions are corrected.

B. Ensure that frame openings are plumb, level, true to line and otherwise properly installed.

C. Inspect each piece of glass immediately before installation, and discard pieces which evidence damage or deterioration including edge damage or face imperfections.

3.01 PREPARATION

A. Clean glazing channel and other framing members to receive glass immediately before glazing.

B. Remove coatings not firmly bonded to substrate. Remove lacquer from metal surfaces abutting elastomeric sealants.

C. Apply primer or sealer to joint surfaces where recommended by sealant manufacturer.

3.02 INSTALLATION

A. Comply with combined recommendations of referenced standards, glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are indicated or specified, and except where manufacturer's technical representatives direct otherwise.

B. Layout:

1. Unify appearance of each series of lites by setting each piece to match others as nearly as possible.

2. Inspect each piece and set with pattern, draw and bow oriented in same direction as other pieces.

C. Setting Blocks:

1. Install setting blocks at sill one-quarter in from each end of the glass, unless otherwise recommended by manufacturer.
2. Use blocks of proper size to support glass.

D. Spacers:

1. Provide spacers for glass sizes larger than 1270 united millimeters (50 united inches) to separate glass from stops except where continuous glazing gaskets or felts are provided.
2. Locate spacers no farther than 600 mm (24 inches) apart and no closer than 300 mm (12 inches) to corners.
3. Place spacers opposite one another. Make bite of spacer on glass a nominal 6 mm (1/4 inch) or greater.

E. End Blocks: Provide end blocks to comply with requirements of referenced glazing standards except where otherwise required by glass manufacturer.

F. Backer Rods: Install compressible filler rods or equivalent back-up material, as recommended by sealant and glass manufacturers.

G. Sealant Glazing:

1. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.
2. Use masking tape to limit coverage of glazing materials to surfaces intended for sealants.
3. Cure sealants for high early strength and durability.
4. Tool exposed surfaces of glazing materials to provide slight wash away from glass.

H. Gasket Glazing:

1. Miter-cut and seal or vulcanize joints of glazing gaskets in accordance with manufacturer's instructions to provide continuous watertight and airtight seal at corners and other locations where joints are required.
2. Butt or lap ends of tape.
3. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage to ensure that gasket will not "walk" out when subjected to movement.
4. Anchor gasket to stop with matching ribs, or by proven adhesives, including embedment of gasket tail in cured heel bead. Set gaskets in silicone sealant at corners.
5. Install exposed tapes or gaskets with slight protrusion above stops in final compressed condition.
6. Conceal edge spacer and seal binding of units with glazing material.

I. Butt Glazing:

1. Comply with sealant and glass manufacturer's recommendations for glazing.
2. Tape polyethylene rod to one side of joint to act as back up for sealant.
3. Install sealant to other side according to manufacturer's instructions.

3.03 CLEANING

A. Clean excess sealant or compound from glass and framing members immediately after application.

B. After installation and until final acceptance, clean glass as frequently as required, but not less than once per month, to remove build-up of dirt, scum, and other substances. Comply with glass manufacturer's recommendations for cleaning.

C. Wash and polish glass on both faces not more than 4 days prior to final acceptance.

D. Comply with glass manufacturer's recommendations for final cleaning.

3.04 PROTECTION

A. Protect glass from breakage after installation. Do not apply markers to surfaces of glass.

B. Remove non-permanent labels.

C. Remove and replace glass which is broken, chipped, cracked, abraded or damaged.

END OF SECTION

SECTION 092900

GYPSUM BOARD – CEMENTBOARD

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Backing panels (interior, epoxy substrate @ walls).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Sustainable Design Submittals:

   1. Product Data: For adhesives and sealants, indicating VOC content.
   2. Laboratory Test Reports: For adhesives and sealants, indicating compliance with requirements for low-emitting materials.
   3. Laboratory Test Reports: For ceiling and wall materials, indicating compliance with requirements for low-emitting materials.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

B. Do not install panels that are wet, moisture damaged, and mold damaged.

   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 CEMENT BOARD

A. Cementitious Backer Panel:
   1. Basis of Design: Subject to compliance with project requirements, the design is based on the following: USG Corporation, LLC, ” USG Durock Cement Board” . (or equal)
   2. Classification: Cementitious Backer Units: ANSI A118.9, ASTM A108.11 and ASTM C 1325 provide with manufacturer's standard edges.
      a. Thickness: **1/2 inch (12.7 mm)**
      b. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
   3. Minimum bending radius: **6 feet (1830 mm)**.
   4. Fastener Requirements: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and application.
      a. Wood Screws: DUROCK Brand Wood or USG Sheathing WF screws, or equal, 1-5/8 inch with corrosion-resistant coating.
      b. Nails: 11-gauge hot-dipped galvanized roofing nails **1-3/4 inch (44 mm)**, **7/16 11 mm** inch diameter head.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

D. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit panels around ducts, pipes, and conduits.
3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

E. Isolate perimeter of board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

F. Wood Framing: Install panels over wood framing. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.

3.3 APPLYING TILE BACKING PANELS

A. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.4 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

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

1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 096720

SEAMLESS EPOXY QUARTZ AND MARBLE-CHIP FLOORING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

A. Fluid applied epoxy quartz and marble-chip flooring and wall finish.

B. Everlast Glaze. (or approved equal)

1.3 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
1. Preparation instructions and recommendations.
2. Storage and handling requirements and recommendations.
3. Installation methods.

C. Selection Samples: For each finish product specified, submit two samples 4 by 4 inches (102 mm by 102 mm) in size illustrating color, chip size and variation, and matrix color.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications:

B. Installer Qualifications: Installation shall be performed by an applicator approved by the manufacturer of the floor surfacing materials. The Contractor shall furnish a certified installer certificate.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
2. Refinish mock-up area as required to produce acceptable work.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.

B. Store materials in accordance with the manufacturer's instructions.
1. Store materials in dry, enclosed area with adequate protection from moisture.

2. Keep containers sealed until ready for use.

C. Storage Temperature: Store between 65 degrees F (18 degrees C) and 90 degrees F (32 degrees C).

1.6 PROJECT CONDITIONS

A. Roof shall be completed and building enclosed prior to flooring commencement.

B. Maintain temperature range of between 65 degrees F (18 degrees C) and 90 degrees F (32 degrees C) 24 hours before, during, and 72 hours after installation of flooring.

C. Ventilate area where flooring is being installed. Post and enforce NO SMOKING or OPEN FLAME signs until flooring has cured.

D. Provide uniform lighting of 50 fc in area of installation.

E. Restrict traffic from area where flooring is being installed or is curing.

1.7 WARRANTY

A. Provide ten year warranty under provisions of Section 01770.

B. Warranty: Include coverage for delamination (separating of layers) of floor and wall materials and degradation of surface finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Everlast Epoxy Systems Inc, which is located at: 637 NW State Road 47 ; Lake City, FL 32025; Tel: 386-719-9979; Fax: 386-719-6982; Email: info@everlastepoxy.com ; Web: www.everlastepoxy.com

B. Substitutions: Approved equal.

2.2 MATERIALS

A. Everlast Floor: A 100 percent solids epoxy, marble-chip and quartz aggregate that is a troweled in place, evenly textured, slip-resistant finish of between 1/8 inch (3 mm) and 3/16 inch (4.8 mm) thickness.
1. System shall not require primer (unless needed due to the substrate), bond coat, grout or sealer components for application.
2. System shall comply with the USDA guidelines for use in federally inspected facilities.

B. Everlast Glaze: The finish of Everlast Floor can range anywhere from glass smooth to a sandpaper-like finish. The texture can be adjusted during or long after by applying multiple coats of glaze (for a smoother finish) or by broadcasting anti-skid into the glaze (for a coarser finish).

The specified finish is:
- Smooth finish. Everlast Floor with 1 coat of Everlast Glaze and no anti-skid.
- Standard finish – Everlast Floor with 1 coat of Everlast Glaze and no anti-skid. This finish is easy to clean with a mop or any other cleaning method and still has some slip-resistance, it is recommended for pet care facilities, public restrooms and any other area that needs to be consistently cleaned and is not always wet.

- Anti-Skid finish – Everlast Floor with 1 coat of Everlast Glaze with medium anti-skid broadcast into the during application. This finish is easy to clean with a deck brush and squeegee or power scrubber, but is not moppable. It is slip-resistant even when wet It is recommended for aquatic facilities, commercial kitchens and any other area that needs to be consistently cleaned and is always wet.
- Super Anti-Skid finish – Everlast Floor with 1 coat of Everlast Glaze with coarse anti-skid broadcast into the during application. This finish is easy to clean with a deck brush and squeegee or power scrubber, but is not moppable. It is slip-resistant even when wet. It is recommended for commercial kitchens and any other area that needs to be consistently cleaned and is always wet and frequently has grease and/or oil on the floor. Note: This finish is extra abrasive and will need to have the glaze and anti-skid reapplied as the skid will wear off in high traffic – frequency depends on traffic.

Acceptable Manufacturer and Product: Seamless flooring material shall be Everlast Epoxy Systems Inc's Everlast Floor, as manufactured by Everlast Epoxy Systems Inc of Lake City, FL. Substitutions are not permitted.

1. Material shall include select silica quartz and marble-chip aggregate fillers.
2. Floor system shall be a 100 percent solid, unpigmented epoxy resin system.
3. Base: A three-component, integral troweled base and cove consisting of Everlast Epoxy Systems Inc’s Everlast Floor resin and hardner, silica quartz and marble-chip aggregates as used in the floor, and finely graded silica aggregate, 6 inches (152 mm) height or as scheduled.
4. Everlast Glaze: Everlast Epoxy Systems Inc’s Everlast Glaze, a high performance, chemical resistant, two-component, clear sealer.
5. Color as selected by Architect from manufacturers standard color range.

PART 4 EXECUTION

4.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.
   1. Verify that substrate is ready to receive work, and that sub-floor surface is clean, dry, and free of substances which could affect bond.
   2. Concrete hydrostatic, capillary or moisture pressure must be no greater than 3.0 lbs./1000 sf/24 hours. Substrates in contact with the ground must have a properly installed, functioning and effective vapor barrier to help prevent potential problems resulting from hydrostatic, capillary or moisture vapor emission. Concrete must contain less than 3% moisture when tested per ASTM D1864.
   3. Maintain minimum concrete surface temperature between 55° and 85° F., and relative humidity below 80% for a minimum of 48 hours before, during , and after installation, or until cured. Surface temperature must be 5° F. Above dew point.
   4. Beginning work constitutes acceptance of substrate.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

4.2 PREPARATION

A. Substrate Requirements:
   1. Contractor to provide positive drainage at floor drains.

2. Floor drains shall be set no higher than 1/8 inch (4 mm) above slab.
3. Floor sinks shall be set in accordance with local codes and regulations.
4. Gaps between wall sheathing and substrate shall be filled prior to flooring commencement per flooring manufacturer's requirements.
5. FRP and any other wall finish should terminate with a J-mould or other trim at least 6 inches (152 mm) above finish floor.
6. The substrate shall be clean, dry and sound. Remove dust, laitance, grease, curing compounds, waxes, foreign particles and any previously applied potentially incompatible coatings by scarifying, chipping, wire brushing, acid etching, or pressure washing. If pressure washing or any other liquid method is used for preparation, substrate should be fully rinsed, squeeze-dry mopped and allowed to completely dry.
7. Concrete: New concrete must cure for at least 28 days at 70°F (21°C), and have been free from water for at least 7 days. Older floors should be scarified and thoroughly cleaned. If badly cracked, crumbling, punky or deeply contaminated with oil or fat, a new concrete topping of proper thickness and strength should be installed. Swollen areas should be chipped out and any cracks, spalls, joints or other depressions filled with our underlayment. The concrete should be at least 2500 psi. Concrete hydrostatic, capillary or moisture pressure must be no greater than 3.0 lbs./1000 sf/24 hours.
8. Wood Floors: The minimum requirement for hardwood floor rigidity (deflection rate) is L/480. Plywood floors shall consist of 2 layers of at least 5/8 inch (16 mm) material with offsetting joints, and screwed (nailing not acceptable) into 16 inches (406 mm) o.c. joists Alternatively, install 1/2 inch (12 mm) concrete backer board, using a quality sub-floor adhesive and deck screws. Seams in the plywood or concrete backer board shall be treated with fiber tape and a blend of Everlast Floor resin and cove base additive. All wood floors are to be treated with a blend of 90% Everlast Glaze and 10% Xylene, and allowed to cure for 12 hours prior to installing Everlast Floor.
9. Vinyl Tile and Sheet Flooring: Thoroughly clean to eliminate wax buildup. Loose tiles and adhesive shall be removed and areas patched with flooring manufacturer's underlayment. Sheet flooring and adhesive shall be completely removed.
10. Quarry / Ceramic Tile: Tile and grout shall be thoroughly cleaned. Loose tile shall be removed and filled in with underlayment. Surface of the tile shall be scratched with a diamond grinder to remove the glaze.
11. Steel Decks: Clean free from oil, grease, rust and loose scale. The deck shall be wiped with denatured alcohol. Allow deck to dry before application of flooring.
12. Radiant Heating System: Everlast Floor can be installed over a radiant heating system if the following 3 conditions are met:

a)The wires are not exposed directly to the floor material. They must be covered by the substrate.
b)The radiant heat system is not more than 140F at the source.
c)Moisture vapor transmission reading must be 3lbs or less.
Everlast Floor should not be used over hydronic (liquid) systems.

More detailed floor preparation guidelines can be found at www.everlastepoxy.com/how-to

4.3 INSTALLATION - FLOORING

A. Apply flooring in accordance with Everlast Epoxy's instructions. Apply to a minimum thickness of 1/8 inch (3 mm). Finish to smooth level surface sloped to drains.

B. Apply Everlast Glaze (and anti-skid, if required).

Review more detailed Everlast Floor installation instructions at www.everlastepoxy.com/how-to

4.4 TOLERANCES

A. Maximum Variation from Flat Surface: 1/8 inch in 10 feet (3 mm in 3 m).

4.5 PROTECTION

A. Protect finished installation during construction.

B. Do not permit traffic over finished floor surfaces for 42 hours.

4.6 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 099000

PAINTING

PART 1 GENERAL

1.01 DEFINITIONS

A. The term "paint", as used in this Section, means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

B. The term "primer", as used in this Section, means the primer, sealer, filler or other first coat material recommended for the substrate by the manufacturer of the finish coat material, except where a specific primer is specified.

C. Touching-up bare spots specified for previously primed or painted surfaces is in addition to the coats specified for the paint system.

1.02 SUBMITTALS

A. Paint Charts: Submit manufacturer’s paint charts for selection of colors. The Director’s Representative shall all approve all color schemes.

1.03 DELIVERY

A. Deliver materials to the Site in original, unopened containers bearing manufacturer's printed label.

1.04 PROJECT CONDITIONS

A. Environmental Requirements:

1. Comply with material manufacturer's printed directions and recommendations as to environmental conditions under which the material can be applied.

    a. Moisture content of material being painted shall be down to a level acceptable to the paint manufacturer.

2. For Type S-1 System(s), comply with the following conditions for application of paint unless otherwise stated in the paint manufacturer's printed directions:

    a. Minimum ambient, steel surface, and paint temperatures: 40 degrees F.

    b. Maximum steel surface temperature: 100 degrees F.

    c. Maximum relative humidity: 85 percent.

3. Do not apply material in areas where dust is being generated or will be generated while the material is drying.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Pipe Painting:

1. Steel primer selected from the following:

a. TNEMEC 10-99 (Red), 10-99G (Green) or 10-1009 (Gray).

b. Rust-Oleum 769.

c. Valspar 13-R-53.

d. Sherwin-Williams "Kromik".

2. If this paint is incompatible with the approved shop paint, use the same paint as the shop paint.

B. Miscellaneous Materials:

1. Turpentine: ASTM D 13.

2. Mineral Spirits (Petroleum Paint Thinner): FS TT-T-291.

3. Color Pigments: Pure, non-fading, finely ground pigments, at least 99 percent passing a 325 mesh sieve. Color pigments that are to be used on masonry, concrete and plaster shall be lime proof.

4. Putty: Water mix type consisting of talc, glue, bentonite and wood flour.

5. Polyester Filler: Polyester resin base autobody filler, standard weight or finishing grade as required by conditions, such as Marson's "White Lightnin" and "Topcoat".

6. Paste Wood Filler: FS TT-F-336.

7. Cleaning Solvents: Low toxicity, and a flash point in excess of 100 degrees F.

C. Finish Colors: The finish color of paint shall be a matte black, as reviewed and approved by the Director’s Representative.

PART 3 EXECUTION

3.01 PREPARATION

A. Protection:

1. Prior to surface preparation and painting, cover or otherwise protect finished Work of other trades and surfaces not being painted concurrently or not to be painted.

2. Apply masking tape or other approved surface protection on all in-place hardware, plates, lighting fixtures, and similar items which are not to be painted,

or else remove such items from the surfaces to be painted. Remove such items where required to properly complete the painting of the adjacent surfaces.

3. Provide "Wet Paint" signs as required to protect newly coated surfaces.

B. Surface Preparation:

1. Perform preparation and cleaning procedures in accordance with the paint manufacturer's instructions and as specified.

a. Previously Painted Surfaces: Remove loose, peeling and blistered coatings by scraping, sanding or chipping. Sand bare spots and abraded areas of previously painted and shop primed surfaces. Where paint is missing or removed, sand surrounding edges of sound paint film so edges of existing paint do not show through the finished system.

b. Sand existing glossy coatings to a uniform dull surface.

c. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease with clean cloths and cleaning solvents prior to other cleaning procedures. Program the cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

d. Touch-up bare spots on previously painted surfaces with primer.

2. Ferrous Metals:

a. Remove dirt and grease with cleaning solvents which will not affect shop prime coat. Wipe off with clean cloths.

b. Remove rust, mill scale and defective paint down to bare metal, using scraper, sandpaper, or wire brush. Grind if necessary to remove shoulders at edge of sound paint to prevent flaws from photographing through finish coats.

c. Steel Pipe Handrails: Clean and touch-up bare spots immediately following erection. Touch-up shall include marred surfaces of the shop coat, field bolts and field welds. Also apply touch-up coat over erection identification marks. Use same type of primer used for the shop coat or use type of primer specified for the painting system. Do not paint steel to be encased in cast-in-place concrete.

C. Materials Preparation:

1. Mix and prepare painting materials in accordance with the manufacturer's directions.

2. Stir materials before and during application to produce and maintain a mixture of uniform density. Do not stir any film which may form on the surface of materials into the material; remove the film and strain the material before using.

3.02 APPLICATION

A. Painted Surfaces:

1. Apply two coats to shop painted and touched-up steel surfaces, except surfaces indicated to receive another type of paint system or sprayed-on fireproofing.

2. Steel surfaces which will be encased in masonry or will not be accessible after the installation of other items of Work, whether the items are in this Contract or in separate related contracts, shall be painted before the installation of such items.

B. Apply paints and finishes by brush except as otherwise specified. Use brushes best suited for the type of material being applied.

C. The number of coats and paint film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has completely dried and has been inspected. If recommended by the manufacturer of the finish coat material, sand between coat applications with fine sandpaper.

1. Apply each material at the manufacturer's recommended spreading rate.

2. Apply additional coats when undercoats, stains, or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance.

D. Apply paint and finishes in even coats of uniform thickness without brush marks, sags, holidays or lap marks.

E. Apply prime coat on woodwork, except for shop primed woodwork, as soon as possible after installation.

3.03 ADJUSTING AND CLEANING

A. Remove masking tape and other protective coverings.

B. Touch up and restore finishes where damaged.

C. Remove spilled, splashed, or spattered paint from defaced surfaces. Do not mar surface finish of item being cleaned.

D. After the final coat has dried, reinstall items which were removed to facilitate the painting. If damaged or defaced during the performance of the Work, restore such items to a condition equal to or better than they were at the time of removal, or provide new matching items.

END OF SECTION

SECTION 131700

WATER FEATURE PLUMBING – ALTERNATE #3

PART 1 – GENERAL

1.00 GENERAL PROVISIONS

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

1.01 DESCRIPTION OF WORK

A. Work Included: Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:
   1. Recirculating and filtered system for Bobcat pond and stream
   2. Recirculating and filtered system for Fox pond and stream – Alternate #1
   3. Plumbing for Porcupine drinking pool – Alternate #2

B. Related Work: The following items are not included in this Section and will be performed under the designated Sections:
   1. Section 033715, Sprayed and Carved Concrete
   2. Section 312000, Earthwork
   3. Section 260500, Electric Work

1.02 QUALITY ASSURANCE

A. Qualifications: The persons performing the Work of this Section and their supervisor shall have been regularly performing such work for a minimum of 5 years.

B. Qualifications for Products Other Than Those Specified: At the time of submission provide written notice to the Director of the intent to propose an “or equal” for products other than those specified. Make the “or equal” submission in a timely manner to allow the Director sufficient time to review the proposed product, perform inspections and witness test demonstrations.

1.03 SUBMITTALS

A. Refer to Section 013300 - Submittals for submittal provisions and procedures.

B. Shop Drawings: Complete detailed drawings for layout of pumps, filters, piping and fittings. Include separate schedule listing all materials required and technical data such as size, weight, and finish, to ensure conformance requirements of contract documents.

C. Product Data: Manufacturer’s catalog cuts, specifications, and installation instructions for each item specified.

D. Samples:
   1. Piping

PART 2 PRODUCTS

2.01 MATERIALS

A. Equipment listed below is an estimate of what is required, refer to Drawings for pool sizes and performance specifications and 1.03 for submittal requirements.

B. Plumbing equipment for Fox pool and stream:

1. AquaSurge PRO 2000-4000 Pump or approved equal.
2. Signature Series BioFalls Filter 2500 with BioBalls or approved equal
3. Signature Series 6.0 Skimmer
4. Pump Check Valve Assembly and Installation Kit
5. Low Water Pump Shutoff Switch
6. Auto Water Fill Valve.
7. Misc. Fittings, Valves, Pipe.

C. Plumbing equipment for Bobcat waterfalls, small pools, and stream:

1. AquaSurge 3000 Pump or approved equal.
2. Signature Series MicroFalls w/Rock Tray and BioFalls or approved equal
3. Signature Series MicroSkim
4. Pump Check Valve Assembly and Installation Kit
5. Low Water Pump Shutoff Switch
6. Auto Water Fill Valve.
7. Misc. Fittings, Valves, Pipe.

D. Plumbing equipment for Porcupine drinking pool:

1. Auto Water Fill Valve.
2. Misc. Fittings, Valves, Pipe

PART 3 EXECUTION

3.01 PREPARATION

A. Submit shop drawing, showing proposed pond and stream layout. Include location and sizes of all pipes, pumps, valves, and filter boxes and drains.

3.02 INSTALLATION

A. Install the work in accordance Manufacturer recommendations and Contract Drawings.

B. Subgrade Preparation: Follow specifications for Sprayed and Carved Concrete (Section 033715).

C. The subgrade shall be compacted in accordance with the Section 312000 to ensure against settlement.

D. Contractor will not be allowed to tie into adjacent electrical facilities or systems until the Director's Representative has reviewed and approved any/all connections.

END OF SECTION 131700

SECTION 220511

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The requirements of this Section shall apply to all sections of Division 22.
B. Definitions:
   1. Exposed: Piping and equipment exposed to view in finished rooms.
C. Abbreviations/Acronyms:
   1. ABS: Acrylonitrile Butadiene Styrene
   2. AC: Alternating Current
   3. ACR: Air Conditioning and Refrigeration
   4. AI: Analog Input
   5. AISI: American Iron and Steel Institute
   6. AO: Analog Output
   7. AWG: American Wire Gauge
   8. BACnet: Building Automation and Control Network
   9. BAg: Silver-Copper-Zinc Brazing Alloy
   10. BAS: Building Automation System
   11. BCuP: Silver-Copper-Phosphorus Brazing Alloy
   12. BSG: Borosilicate Glass Pipe
   13. CDA: Copper Development Association
   14. C: Celsius
   15. CLR: Color
   16. CO: Cleanout
   17. COTG: Cleanout to Grade
   18. CPVC: Chlorinated Polyvinyl Chloride
   19. CR: Chloroprene
   20. CRS: Corrosion Resistant Steel
   21. CWP: Cold Working Pressure
   22. CxA: Commissioning Agent
   23. db(A): Decibels (A weighted)
   24. DCOTG: Double Cleanout to Grade
   25. DI: Digital Input
   26. DISS: Diameter Index Safety System
   27. DO: Digital Output
   28. DVD: Digital Video Disc
   29. DN: Diameter Nominal
   30. DWV: Drainage, Waste and Vent
   31. ECC: Engineering Control Center
   32. EPDM: Ethylene Propylene Diene Monomer
   33. EPT: Ethylene Propylene Terpolymer
   34. ETO: Ethylene Oxide
   35. F: Fahrenheit
   36. FCO: Floor Cleanout
   37. FD: Floor Drain
   38. FED: Federal
   39. FG: Fiberglass
   40. FNPT: Female National Pipe Thread
   41. FPM: Fluoroelastomer Polymer

42. GPM: Gallons Per Minute
43. HDPE: High Density Polyethylene
44. Hg: Mercury
45. HOA: Hands-Off-Automatic
46. HP: Horsepower
47. HVE: High Volume Evacuation
48. ID: Inside Diameter
49. IPS: Iron Pipe Size
50. Kg: Kilogram
51. kPa: Kilopascal
52. lb: Pound
53. L/s: Liters Per Second
54. L/min: Liters Per Minute
55. MAWP: Maximum Allowable Working Pressure
56. MAX: Maximum
57. MED: Medical
58. m: Meter
59. MFG: Manufacturer
60. mg: Milligram
61. mg/L: Milligrams per Liter
62. ml: Milliliter
63. mm: Millimeter
64. MIN: Minimum
65. NF: Oil Free Dry (Nitrogen)
66. NPTF: National Pipe Thread Female
67. NPS: Nominal Pipe Size
68. NPT: Nominal Pipe Thread
69. OD: Outside Diameter
70. OSD: Open Sight Drain
71. OS&Y: Outside Stem and Yoke
72. OXY: Oxygen
73. PBPU: Prefabricated Bedside Patient Units
74. PH: Power of Hydrogen
75. PLC: Programmable Logic Controllers
76. PP: Polypropylene
77. PPM: Parts per Million
78. PSIG: Pounds per Square Inch
79. PTFE: Polytetrafluoroethylene
80. PVC: Polyvinyl Chloride
81. PVDF: Polyvinylidene Fluoride
82. RAD: Radians
83. RO: Reverse Osmosis
84. RPM: Revolutions Per Minute
85. RTRP: Reinforced Thermosetting Resin Pipe
86. SCFM: Standard Cubic Feet Per Minute
87. SDI: Silt Density Index
88. SPEC: Specification
89. SPS: Sterile Processing Services
90. STD: Standard
91. SUS: Saybolt Universal Second
92. SWP: Steam Working Pressure
93. TEFC: Totally Enclosed Fan-Cooled
94. TFE: Tetrafluoroethylene
95. THHN: Thermoplastic High-Heat Resistant Nylon Coated Wire
96. THWN: Thermoplastic Heat & Water Resistant Nylon Coated Wire

97. T/P: Temperature and Pressure
98. USDA: U.S. Department of Agriculture
99. V: Volt
100. VAC: Vacuum
101. VAC: Voltage in Alternating Current
102. WAGD: Waste Anesthesia Gas Disposal
103. WOG: Water, Oil, Gas

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below shall form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. American Society for Testing and Materials (ASTM):
A36/A36M-2012 ..... Standard Specification for Carbon Structural Steel
A575-96(R2013)e1 ..... Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
E84-2013a ..... Standard Test Method for Surface Burning Characteristics of Building Materials
E119-2012a ..... Standard Test Methods for Fire Tests of Building Construction and Materials
F1760-01(R2011) ..... Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
D. New York State Codes Council:
NYSBC-2010 ..... New York State Building Code
NYSPC-2010 ..... New York State Plumbing Code
NYFGC-2010 ..... New York Fuel Gas Code
E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc.:
SP-58-2009 ..... Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation
SP-69-2003 ..... Pipe Hangers and Supports - Selection and Application
F. Deleted
G. National Electrical Manufacturers Association (NEMA):
MG 1-2011 ..... Motors and Generators
H. National Fire Protection Association (NFPA):
51B-2014 ..... Standard for Fire Prevention During Welding, Cutting and Other Hot Work
54-2012 ..... National Fuel Gas Code
70-2014 ..... National Electrical Code (NEC)
I. NSF International (NSF):
5-2012 ..... Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
14-2012 ..... Plastic Piping System Components and Related Materials
61-2012 ..... Drinking Water System Components – Health Effects
372-2011 ..... Drinking Water System Components – Lead Content

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted for review by the owner and engineer.
B. Information and material submitted under this section shall be marked "SUBMITTED UNDER SECTION 220511, COMMON WORK RESULTS FOR PLUMBING", with applicable paragraph identification.

C. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
D. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
E. Prior to submitting shop drawings for approval, contractor shall certify in writing that manufacturers of all major items of equipment have each reviewed drawings and specifications, and have jointly coordinated and properly integrated their equipment and controls to provide a complete and efficient installation.
F. Installing Contractor shall provide lists of previous installations for selected items of equipment. Contact persons who will serve as references, with telephone numbers and e-mail addresses shall be submitted with the references.
G. Manufacturer's Literature and Data: Manufacturer’s literature shall be submitted under the pertinent section rather than under this section.
    1. Electric motor data and variable speed drive data shall be submitted with the driven equipment.
    2. Equipment and materials identification.
    3. Firestopping materials.
    4. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
    5. Wall, floor, and ceiling plates.
H. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
I. Coordination Drawings: Complete consolidated and coordinated layout drawings shall be submitted for all new systems, and for existing systems that are in the same areas. The drawings shall include plan views, elevations and sections of all systems and shall be on a scale of not less than 1:32 (3/8 inch equal to one foot). Clearly identify and dimension the proposed locations of the principal items of equipment. The drawings shall clearly show the proposed location and adequate clearance for all equipment, controls, piping, pumps, valves and other items. All valves, trap primer valves, water hammer arrestors, strainers, and equipment requiring service shall be provided with an access door sized for the complete removal of plumbing device, component, or equipment. Equipment foundations shall not be installed until equipment or piping layout drawings have been approved. Detailed layout drawings shall be provided for all piping systems. In addition, details of the following shall be provided.
    1. Mechanical equipment rooms.
    2. Interstitial space.
    3. Hangers, inserts, supports, and bracing.
    4. Pipe sleeves.
    5. Equipment penetrations of floors, walls, ceilings, or roofs.
J. Maintenance Data and Operating Instructions:
    1. Maintenance and operating manuals for systems and equipment. Include complete list indicating all components of the systems with diagrams of the internal wiring for each item of equipment.
    2. Include listing of recommended replacement parts for keeping in stock supply, including sources of supply, for equipment shall be provided. The listing shall include belts for equipment: Belt manufacturer, model number, size and style, and distinguished whether of multiple belt sets.

1.5 QUALITY ASSURANCE

A. Products Criteria:
   1. Standard Products: Material and equipment shall be the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years. However, digital electronics devices, software and systems such as controls, instruments, computer work station, shall be the current generation of technology and basic design that has a proven satisfactory service record of at least 5 years.
   2. Equipment Service: There shall be permanent service organizations, authorized and trained by manufacturers of the equipment supplied, located within 160 km (100 miles) of the project. These organizations shall come to the site and provide acceptable service to restore operations within four hours of receipt of notification by phone, e-mail or fax in event of an emergency, such as the shut-down of equipment; or within 24 hours in a non-emergency. Names, mail and e-mail addresses and phone numbers of service organizations providing service under these conditions for (as applicable to the project): pumps, compressors, water heaters, critical instrumentation, computer workstation and programming shall be submitted for project record and inserted into the operations and maintenance manual.
   3. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
   4. The products and execution of work specified in Division 22 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced, if required by local authorities such as the natural gas supplier. If the local codes are more stringent, then the local code shall apply. Any conflicts shall be brought to the attention of the Owner and Engineer.
   5. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
   6. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
   7. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
   8. Asbestos products or equipment or materials containing asbestos shall not be used.
B. Welding: Before any welding is performed, contractor shall submit a certificate certifying that welders comply with the following requirements:
   1. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code", Section IX, "Welding and Brazing Qualifications".
   2. Comply with provisions of ASME B31 series "Code for Pressure Piping".
   3. Certify that each welder and welding operator has passed American Welding Society (AWS) qualification tests for the welding processes involved, and that certification is current.
   4. All welds shall be stamped according to the provisions of the American Welding Society.
C. Manufacturer's Recommendations: Where installation procedures or any part thereof are required to be in accordance with the recommendations of the manufacturer of the material being installed, printed copies of these recommendations shall be furnished to the Owner and Engineer prior to installation. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations can be cause for rejection of the material.
D. Execution (Installation, Construction) Quality:
   1. All items shall be applied and installed in accordance with manufacturer's written instructions. Conflicts between the manufacturer's instructions and the contract documents shall be referred to the Owner and Engineer for resolution. Printed copies or electronic files of manufacturer’s installation instructions shall be provided to the Owner and Engineer at least 10 working days prior to commencing installation of any item.
   2. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these

items include, but are not limited to: all types of valves, filters and strainers, transmitters, and control devices. Prior to commencing installation work, refer conflicts between this requirement and contract documents to Owner and Engineer for resolution.

3. Complete layout drawings shall be required by Paragraph, SUBMITTALS. Construction work shall not start on any system until the layout drawings have been approved by Owner and Engineer.
4. Installer Qualifications: Installer shall be licensed and shall provide evidence of the successful completion of at least five projects of equal or greater size and complexity. Provide tradesmen skilled in the appropriate trade.
5. If an installation is unsatisfactory to the Owner and Engineer, the Contractor shall correct the installation at no additional cost or additional time to the Owner.

E. Guaranty: Warranty of Construction, FAR clause 52.246-21.
F. Plumbing Systems: New York State Plumbing Code. Unless otherwise required herein, perform plumbing work in accordance with the latest version of the NYSPC. For NYSPC codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word “should” shall be interpreted as “shall”. Reference to the “code official” or “owner” shall be interpreted to mean the Owner and Engineer.
G. Cleanliness of Piping and Equipment Systems:
   1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
   2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
   3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Owner. All piping shall be tested in accordance with the specifications and the New York State Plumbing Code (NYSPC). All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
   4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protection of Equipment:
   1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Owner has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
   2. Damaged equipment shall be replaced with an identical unit as determined and directed by the Owner and Engineer. Such replacement shall be at no additional cost or additional time to the Owner.
   3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.
   4. Existing equipment and piping being worked on by the Contractor shall be under the custody and responsibility of the Contractor and shall be protected as required for new work.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.
B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List

of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them on Auto-Cad version 2010 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
D. Certification documentation shall be provided prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits specified.

PART 2 – PRODUCTS

2.1 MATERIALS FOR VARIOUS SERVICES

A. Non-pressure PVC pipe shall contain a minimum of 25 percent recycled content. Steel pipe shall contain a minimum of 25 percent recycled content.
B. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61. Solder or flux containing lead shall not be used with copper pipe.
C. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.
D. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.
E. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

2.2 FACTORY-ASSEMBLED PRODUCTS

A. Standardization of components shall be maximized to reduce spare part requirements.
B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
    1. All components of an assembled unit need not be products of same manufacturer.
    2. Constituent parts that are alike shall be products of a single manufacturer.
    3. Components shall be compatible with each other and with the total assembly for intended service.
    4. Contractor shall guarantee performance of assemblies of components, and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly at no additional cost or time to the Owner.
C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
D. Major items of equipment, which serve the same function, shall be the same make and model.

2.3 COMPATIBILITY OF RELATED EQUIPMENT

A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

2.4 SAFETY GUARDS

A. Pump shafts and couplings shall be fully guarded by a sheet steel guard, covering coupling and shaft but not bearings. Material shall be minimum 16-gage sheet steel; ends shall be braked and drilled and attached to pump base with minimum of four 8 mm (1/4 inch) bolts. Reinforce guard as necessary to prevent side play forcing guard onto couplings.
B. All Equipment shall have moving parts protected from personal injury.

2.5 LIFTING ATTACHMENTS

A. Equipment shall be provided with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.

2.6 EQUIPMENT AND MATERIALS IDENTIFICATION

A. Use symbols, nomenclature and equipment numbers specified, shown on the drawings, or shown in the maintenance manuals.
B. Interior (Indoor) Equipment: Engraved nameplates, with letters not less than 7 mm (3/16 inch) high of brass with black-filled letters, or rigid black plastic with white letters specified in Section 09 91 00, PAINTING shall be permanently fastened to the equipment. Unit components such as water heaters, tanks, coils, filters, etc. shall be identified.
C. Exterior (Outdoor) Equipment: Brass nameplates, with engraved black filled letters, not less than 7 mm (3/16 inch) high riveted or bolted to the equipment.
D. Control Items: All temperature, pressure, and controllers shall be labeled and the component's function identified. Identify and label each item as they appear on the control diagrams.
E. Valve Tags and Lists:
    1. Plumbing: All valves shall be provided with valve tags and listed on a valve list (Fixture stops not included).
    2. Valve tags: Engraved black filled numbers and letters not less than 15 mm (1/2 inch) high for number designation, and not less than 8 mm (1/4 inch) for service designation on 19 gage, 40 mm (1-1/2 inches) round brass disc, attached with brass "S" hook or brass chain.
    3. Valve lists: Valve lists shall be created using a word processing program and printed on plastic coated cards. The plastic coated valve list card(s), sized 215 mm (8-1/2 inches) by 275 mm (11 inches) shall show valve tag number, valve function and area of control for each service or system. The valve list shall be in a punched 3-ring binder notebook. An additional copy of the valve list shall be mounted in picture frames for mounting to a wall. Owner and Engineer shall instruct contractor where frames shall be mounted.
    4. A detailed plan for each floor of the building indicating the location and valve number for each valve shall be provided in the 3-ring binder notebook. Each valve location shall be identified with a color coded sticker or thumb tack in ceiling or access door.

2.9 FIRESTOPPING

A. Section 078400, FIRESTOPPING specifies an effective barrier against the spread of fire, smoke and gases where penetrations occur for piping. Refer to Section 220711, PLUMBING INSULATION, for pipe insulation.

2.10 GALVANIZED REPAIR COMPOUND

A. Mil. Spec. DOD-P-21035B, paint.

2.11 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

A. In lieu of the paragraph which follows, suspended equipment support and restraints may be designed and installed in accordance with the New York State Building Code (IBC). Submittals based on the New York State Building Code (IBC) requirements, or the following paragraphs of this Section shall be stamped and signed by a professional engineer registered in the state where the project is located. The Support system of suspended equipment over 227 kg (500 pounds)

shall be submitted for approval of the Owner and Engineer in all cases. See the above specifications for lateral force design requirements.

B. Type Numbers Specified: For materials, design, manufacture, selection, application, and installation refer to MSS SP-58. For selection and application refer to MSS SP-69.
C. For Attachment to Concrete Construction:
   1. Concrete insert: Type 18, MSS SP-58.
   2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 100 mm (4 inches) thick when approved by the COR for each job condition.
   3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 100 mm (4 inches) thick when approved by the Owner and Engineer for each job condition.
D. For Attachment to Steel Construction: MSS SP-58.
   1. Welded attachment: Type 22.
   2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 23 mm (7/8 inch) outside diameter.
E. For Attachment to Wood Construction: Wood screws or lag bolts.
F. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 40 mm (1-1/2 inches) minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
G. Multiple (Trapeze) Hangers: Galvanized, cold formed, lipped steel channel horizontal member, not less than 43 mm by 43 mm (1-5/8 inches by 1-5/8 inches), 2.7 mm (No. 12 gage), designed to accept special spring held, hardened steel nuts.
   1. Allowable hanger load: Manufacturers rating less 91kg (200 pounds).
   2. Guide individual pipes on the horizontal member of every other trapeze hanger with 8 mm (1/4 inch) U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 15 mm (1/2 inch) galvanized steel bands, or insulated calcium silicate shield for insulated piping at each hanger.
H. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, PLUMBING INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
   1. General Types (MSS SP-58):
      a. Standard clevis hanger: Type 1; provide locknut.
      b. Riser clamps: Type 8.
      c. Wall brackets: Types 31, 32 or 33.
      d. Roller supports: Type 41, 43, 44 and 46.
      e. Saddle support: Type 36, 37 or 38.
      f. Turnbuckle: Types 13 or 15.
      g. U-bolt clamp: Type 24.
      h. Copper Tube:
         1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
         2) For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
         3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
         4) Insulated Lines: Provide pre-insulated calcium silicate shields sized for copper tube.
      i. Supports for plastic or glass piping: As recommended by the pipe manufacturer with black rubber tape extending one inch beyond steel support or clamp.
      j. Spring hangers are required on all plumbing system pumps one horsepower and greater.
   2. Plumbing Piping (Other Than General Types):
      a. Horizontal piping: Type 1, 5, 7, 9, and 10.
      b. Chrome plated piping: Chrome plated supports.

c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 1.3 mm (18 gage) minimum.

J. Pre-insulated Calcium Silicate Shields:
1. Provide 360 degree water resistant high density 965 kPa (140 psig) compressive strength calcium silicate shields encased in galvanized metal.
2. Pre-insulated calcium silicate shields to be installed at the point of support during erection.
3. Shield thickness shall match the pipe insulation.
4. The type of shield is selected by the temperature of the pipe, the load it must carry, and the type of support it will be used with.
a. Shields for supporting cold water shall have insulation that extends a minimum of 25 mm (1 inch) past the sheet metal.
b. The insulated calcium silicate shield shall support the maximum allowable water filled span as indicated in MSS SP-69. To support the load, the shields shall have one or more of the following features: structural inserts 4138 kPa (600 psig) compressive strength, an extra bottom metal shield, or formed structural steel (ASTM A36/A36M) wear plates welded to the bottom sheet metal jacket.
5. Shields may be used on steel clevis hanger type supports, trapeze hangers, roller supports or flat surfaces.

2.12 PIPE PENETRATIONS

A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
C. To prevent accidental liquid spills from passing to a lower level, provide the following:
1. For sleeves: Extend sleeve 25 mm (1 inch) above finished floor and provide sealant for watertight joint.
2. For blocked out floor openings: Provide 40 mm (1-1/2 inch) angle set in silicone adhesive around opening.
3. For drilled penetrations: Provide 40 mm (1-1/2 inch) angle ring or square set in silicone adhesive around penetration.
D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of Owner and Engineer.
E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 25 mm (1 inch) greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 25 mm (1 inch) in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.

J. Sealant and Adhesives: Shall be as specified in Section 079200, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 200 mm (8 inches) from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 250 mm (10 inches) up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

2.13 TOOLS AND LUBRICANTS

A. Furnish, and turn over to the Owner and Engineer, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.
B. Grease Guns with Attachments for Applicable Fittings: One for each type of grease required for each motor or other equipment.
C. Tool Containers: metal, permanently identified for intended service and mounted, or located, where directed by the Owner and Engineer.
D. Lubricants: A minimum of 0.95 L (1 quart) of oil, and 0.45 kg (1 pound) of grease, of equipment manufacturer's recommended grade and type, in unopened containers and properly identified as to use for each different application. Bio-based materials shall be utilized when possible.

2.14 WALL, FLOOR AND CEILING PLATES

A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
B. Thickness: Not less than 2.4 mm (3/32 inch) for floor plates. For wall and ceiling plates, not less than 0.64 mm (0.025 inch) for up to 75 mm (3 inch) pipe, 0.89 mm (0.035 inch) for larger pipe.
C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

2.15 ASBESTOS

A. Materials containing asbestos are not permitted.

PART 3 - EXECUTION

3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities. Equipment layout drawings shall be prepared to coordinate proper location and personnel access of all facilities. The drawings shall be submitted for review.
B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to: all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.

F. Cutting Holes:
   1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by Owner and Engineer. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to Owner and Engineer for approval.
   2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
   3. Holes through concrete and masonry shall be cut by rotary core drill. Pneumatic hammer, impact electric, and hand or manual hammer type drill will not be allowed, except as permitted by Owner and Engineer where working area space is limited.

G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.

H. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.

I. Protection and Cleaning:
   1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Owner and Engineer. Damaged or defective items in the opinion of the Owner and Engineer, shall be replaced at no additional cost or time to the Owner.
   2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.

J. Concrete and Grout: Concrete and shrink compensating grout 25 MPa (3000 psig) minimum, specified in Section 03 30 00, CAST-IN-PLACE CONCRETE, shall be used for all pad or floor mounted equipment.

K. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.

L. Interconnection of Controls and Instruments: Electrical interconnection is generally not shown but shall be provided. This includes interconnections of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations. Comply with NFPA 70.

M. Deleted.

N. Deleted

O. Deleted.

P. Work in bathrooms, restrooms, housekeeping closets: All pipe penetrations behind escutcheons shall be sealed with plumber’s putty.

Q. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.

R. Inaccessible Equipment:
   1. Where the Engineer determines that the Contractor has installed equipment not conveniently accessible for operation and maintenance, equipment shall be removed and reinstalled or remedial action performed as directed at no additional cost or additional time to the Owner.
   2. The term "conveniently accessible" is defined as capable of being reached without the use of ladders, or without climbing or crawling under or over obstacles such as electrical conduit, motors, fans, pumps, belt guards, transformers, high voltage lines, piping, and ductwork.

3.2 TEMPORARY PIPING AND EQUIPMENT

A. Continuity of operation of existing facilities may require temporary installation or relocation of equipment and piping. Temporary equipment or pipe installation or relocation shall be provided to maintain continuity of operation of existing facilities.
B. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of paragraph 3.1 shall apply.
C. Temporary facilities and piping shall be completely removed back to the nearest active distribution branch or main pipe line and any openings in structures sealed. Dead legs are not allowed in potable water systems. Necessary blind flanges and caps shall be provided to seal open piping remaining in service.

3.3 RIGGING

A. Openings in building structures shall be planned to accommodate design scheme.
B. Alternative methods of equipment delivery may be offered and will be considered by Engineer under specified restrictions of phasing and service requirements as well as structural integrity of the building.
C. All openings in the building shall be closed when not required for rigging operations to maintain proper environment in the facility for Engineer operation and maintenance of service.
D. Contractor shall provide all facilities required to deliver specified equipment and place on foundations. Attachments to structures for rigging purposes and support of equipment on structures shall be Contractor's full responsibility.
E. Contractor shall check all clearances, weight limitations and shall provide a rigging plan designed by a Registered Professional Engineer. All modifications to structures, including reinforcement thereof, shall be at Contractor's cost, time and responsibility.
F. Rigging plan and methods shall be referred to Owner and Engineer for evaluation prior to actual work.

3.4 PIPE AND EQUIPMENT SUPPORTS

A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Holes shall be drilled or burned in structural steel ONLY with the prior written approval of the Owner and Engineer.
B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.
C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 15 mm (1/2 inch) clearance between pipe or piping covering and adjacent work shall be provided.
D. For horizontal and vertical plumbing pipe supports, refer to the New York State Plumbing Code (NYSPC) and these specifications.
E. Overhead Supports:
    1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
    2. Provide steel structural members, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
    3. Tubing and capillary systems shall be supported in channel troughs.
F. Floor Supports:
    1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.

2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 50 mm (2 inch) excess on all edges. Structural drawings shall be reviewed for additional requirements. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a grout material to permit alignment and realignment.

3.5 LUBRICATION

A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one liter (one quart) of oil and 0.45 kg (1 pound) of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered to Owner and Engineer in unopened containers that are properly identified as to application.
C. A separate grease gun with attachments for applicable fittings shall be provided for each type of grease applied.
D. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.
E. All lubrication points shall be extended to one side of the equipment.

3.6 PLUMBING SYSTEMS DEMOLITION

A. Rigging access, other than indicated on the drawings, shall be provided after approval for structural integrity by the Owner and Engineer. Such access shall be provided without additional cost or time to the Engineer. Where work is in an operating plant, approved protection from dust and debris shall be provided at all times for the safety of plant personnel and maintenance of plant operation and environment of the plant.
B. Deleted.
C. Unless specified otherwise, all piping, wiring, conduit, and other devices associated with the equipment not re-used in the new work shall be completely removed from the property and properly disposed of. This includes all concrete equipment pads, pipe, valves, fittings, insulation, and all hangers including the top connection and any fastenings to building structural systems. All openings shall be sealed after removal of equipment, pipes, ducts, and other penetrations in roof, walls, floors, in an approved manner and in accordance with plans and specifications where specifically covered. Structural integrity of the building system shall be maintained. Reference shall also be made to the drawings and specifications of the other disciplines in the project for additional facilities to be demolished or handled.
D. All valves including gate, globe, ball, butterfly and check, all pressure gages and thermometers with wells shall remain the Owner’s property and shall be removed and delivered to the Owner and stored as directed. The Contractor shall remove all other material and equipment, devices and demolition debris under these plans and specifications. Such material shall be removed from the property expeditiously and shall not be allowed to accumulate.

3.7 CLEANING AND PAINTING

A. Prior to final inspection and acceptance of the plant and facilities for beneficial use by the Owner, the plant facilities, equipment and systems shall be thoroughly cleaned and painted. Refer to Section 099100, PAINTING.
B. In addition, the following special conditions apply:
    1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks. All rust shall be removed prior to painting and from surfaces to remain unpainted. Scratches, scuffs, and abrasions shall be repaired prior to applying prime and finish coats.
    2. The following Material and Equipment shall NOT be painted:
        a. Motors, controllers, control switches, and safety switches.

b. Control and interlock devices.
c. Regulators.
d. Pressure reducing valves.
e. Control valves and thermostatic elements.
f. Lubrication devices and grease fittings.
g. Copper, brass, aluminum, stainless steel and bronze surfaces.
h. Valve stems and rotating shafts.
i. Pressure gages and thermometers.
j. Glass.
k. Name plates.

3. Control and instrument panels shall be cleaned and damaged surfaces repaired. Touch-up painting shall be made with matching paint type and color obtained from manufacturer or computer matched.
4. Pumps, motors, steel and cast iron bases, and coupling guards shall be cleaned, and shall be touched-up with the same paint type and color as utilized by the pump manufacturer.
5. Temporary Facilities: Apply paint to surfaces that do not have existing finish coats per Section 099100, Painting.
6. The final result shall be a smooth, even-colored, even-textured factory finish on all items. The entire piece of equipment shall be repainted, if necessary, to achieve this. Lead based paints shall not be used.

3.8 IDENTIFICATION SIGNS

A. Laminated plastic signs, with engraved lettering not less than 7 mm (3/16 inch) high, shall be provided that designates equipment function, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, and performance data shall be placed on factory built equipment.
C. Pipe Identification: Refer to Section 09 91 00, PAINTING.

3.9 STARTUP AND TEMPORARY OPERATION

A. Startup of equipment shall be performed as described in the equipment specifications. Vibration within specified tolerance shall be verified prior to extended operation.

3.10 OPERATING AND PERFORMANCE TESTS

A. Prior to the final inspection, all required tests shall be performed and submit the test reports and records to the Owner and Engineer.
B. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.
C. When completion of certain work or systems occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then conduct such performance tests and finalize control settings during the first actual seasonal use of the respective systems following completion of work. Rescheduling of these tests shall be requested in writing to Owner and Engineer for approval.

3.11 OPERATION AND MAINTENANCE MANUALS

A. All new and temporary equipment and all elements of each assembly shall be included.
B. Data sheet on each device listing model, size, capacity, pressure, speed, horsepower, impeller size, and other information shall be included.
C. Manufacturer’s installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating

precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

D. Lubrication instructions, type and quantity of lubricant shall be included.
E. Schematic diagrams and wiring diagrams of all control systems corrected to include all field modifications shall be included.
F. Set points of all interlock devices shall be listed.
G. Trouble-shooting guide for the control system troubleshooting shall be inserted into the Operations and Maintenance Manual.
H. The control system sequence of operation corrected with submittal review comments shall be inserted into the Operations and Maintenance Manual.
I. Emergency procedures for shutdown and startup of equipment and systems.

3.13 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four [4] hours to instruct personnel in operation and maintenance of the system.

END OF SECTION

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
B. A complete listing of all acronyms and abbreviations are included in Section 220511, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 01 00 00, GENERAL REQUIREMENTS.
B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. American Society of Mechanical Engineers (ASME):
A112.14.1-2003 ..... Backwater Valves
C. American Society of Sanitary Engineering (ASSE):
1001-2008 ..... Performance Requirements for Atmospheric Type Vacuum Breakers
1003-2009 ..... Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
1011-2004 ..... Performance Requirements for Hose Connection Vacuum Breakers
1013-2011 ..... Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
1015-2011 ..... Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
1017-2009 ..... Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
1020-2004 ..... Performance Requirements for Pressure Vacuum Breaker Assembly
1035-2008 ..... Performance Requirements for Laboratory Faucet Backflow Preventers
1069-2005 ..... Performance Requirements for Automatic Temperature Control Mixing Valves
1070-2004 ..... Performance Requirements for Water Temperature Limiting Devices
1071-2012 ..... Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment
D. American Society for Testing and Materials (ASTM):
A126-2004(R2009) ..... Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
A276-2013a ..... Standard Specification for Stainless Steel Bars and Shapes
A536-1984(R2009) ..... Standard Specification for Ductile Iron Castings
B62-2009 ..... Standard Specification for Composition Bronze or Ounce Metal Castings

B584-2013.....Standard Specification for Copper Alloy Sand Castings for General Applications

E. New York State Codes Council:
NYSBC-2010.....New York State Building Code
NYSPC-2010.....New York State Plumbing Code
NYFGC-2010…….New York Fuel Gas Code

F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
SP-25-2008 .....Standard Marking Systems for Valves, Fittings, Flanges and Unions
SP-67-2011 .....Butterfly Valves
SP-70-2011 .....Gray Iron Gate Valves, Flanged and Threaded Ends
SP-71-2011 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends
SP-80-2013 .....Bronze Gate, Globe, Angle, and Check Valves
SP-85-2011 .....Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
SP-110-2010 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

G. National Environmental Balancing Bureau (NEBB):
7th Edition 2005 Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems

H. NSF International (NSF):
61-2012 .....Drinking Water System Components – Health Effects
372-2011 .....Drinking Water System Components – Lead Content

I. University of Southern California Foundation for Cross Connection Control and Hydraulic Research (USC FCCCHR):
9th Edition .....Manual of Cross-Connection Control

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 013323, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.

B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 220523, GENERAL-DUTY VALVES FOR PLUMBING PIPING”, with applicable paragraph identification.

C. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Ball Valves.
2. Gate Valves.
3. Butterfly Valves.
4. Balancing Valves.
5. Check Valves.
6. Globe Valves.
7. Water Pressure Reducing Valves and Connections.
8. Backwater Valves.
9. Backflow Preventers.
10. Chainwheels.
11. Thermostatic Mixing Valves.

D. Test and Balance reports for balancing valves.

E. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replaceable parts:
1. Include complete list indicating all components of the systems.
2. Include complete diagrams of the internal wiring for each item of equipment.
3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
4. Piping diagrams of thermostatic mixing valves to be installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Valves shall be prepared for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, grooves, and weld ends.
   3. Set angle, gate, and globe valves closed to prevent rattling.
   4. Set ball and plug valves open to minimize exposure of functional surfaces.
   5. Set butterfly valves closed or slightly open.
   6. Block check valves in either closed or open position.
B. Valves shall be prepared for storage as follows:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew point temperature.
C. A sling shall be used for large valves. The sling shall be rigged to avoid damage to exposed parts. Hand wheels or stems shall not be used as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Asbestos packing and gaskets are prohibited.
B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.
C. Valves in insulated piping shall have 50 mm or DN50 (2 inch) stem extensions and extended handles of non-thermal conductive material that allows operating the valve without breaking the vapor seal or disturbing the insulation. Memory stops shall be fully adjustable after insulation is applied.
D. Exposed Valves over 65 mm or DN65 (2-1/2 inches) installed at an elevation over 3.6 m (12 feet) shall have a chain-wheel attachment to valve hand-wheel, stem, or other actuator.
E. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:
   1. 50 mm or DN50 (2 inches) and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 1035 kPa (150 psig) and a CWP rating of 4138 kPa (600 psig). The body material shall be Lead-Free Bronze ASTM B584, Alloy C844 (wetted surfaces shall contain no more than 0.25% lead by weighted average). The ends shall be non-lead solder.
   2. Less than 100 mm DN100 (4 inches): Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 1380 kPa (200 psig). The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
   3. 100 mm DN100 (4 inches) and larger:
      a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under 200 mm or DN200 (8 inches) and crank operated for sizes 200 mm or DN200 (8 inches) and above.
      b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 1380 kPa (200 psig). The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.
      c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 1380 kPa

(200 psig). The valve materials shall be epoxy coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.

B. Reagent Grade Water: Valves for reagent grade, reverse osmosis, or deionized water service shall be ball type of same material as used for pipe.

2.3 BALANCING VALVES

A. Hot Water Re-circulating, 75 mm or DN75 (3 inches) and smaller manual balancing valve shall be of lead-free bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff (wetted surfaces shall contain no more than 0.25% lead by weighted average). The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have 8 mm or DN8 NPT (1/4 inch NPT) tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.
B. Larger than 75 mm or DN75 (3 inches): Manual balancing valves shall be of heavy duty cast iron flanged construction with 861 kPa (125 psig) flange connections. The flanged manual balancing valves shall have either a brass ball with glass and carbon filled TFE seal rings or fitted with a bronze seat, replaceable bronze disc with EPDM seal insert and stainless steel stem. The design pressure shall be 1200 kPa (175 psig) at 121 degrees C (250 degrees F).

2.4 CHECK VALVES

A. 75 mm or DN75 (3 inches) and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.
B. 100 mm or DN100 (4 inches) and larger:
    1. Check valves shall be Class 125, iron swing check valve with lever and weight closure control. The check valve shall meet MSS SP-71 Type I standard. The check valve shall have a CWP rating of 1380 kPa (200 psig). The check valve shall have a clear or full waterway body design with gray iron body material conforming to ASTM A126, bolted bonnet, flanged ends, bronze trim.
    2. All check valves on the discharge side of submersible sump pumps shall have factory installed exterior level and weight with sufficient weight to prevent the check valve from hammering against the seat when the sump pump stops.

2.5 GLOBE VALVES

A. 75 mm or DN75 (3 inches) or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 2070 kPa (300 psig). The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.
B. Larger than 75 mm or DN75 (3 inches): Similar to above, except with cast iron body and bronze trim, Class 125, iron globe valve. The globe valve shall meet MSS SP-85, Type 1 standard. The globe valve shall have a CWP rating of 1380 kPa (200 psig). The valve material shall be gray iron with bolted bonnet conforming to ASTM A126 with flanged ends, bronze trim, and malleable iron handwheel.

2.6 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

A. 75 mm or DN75 (3 inches) or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The pressure reducing valve shall meet ASSE 1003. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no

flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.

B. 100 mm or DN100 (4 inches) and larger: The pressure reducing valve shall consist of a flanged cast iron body and rated to 1380 kPa (200 psig). The valve shall have a large elastomer diaphragm for sensitive response. The pressure reducing valve shall meet ASSE 1003.
C. The regulator shall have a tap for pressure gauge.
D. The regulator shall have a temperature rating of 100 degrees C (212 degrees F) for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to 6.9 kPa (+/- 1 psig).
E. Setting: Entering water pressure, discharge pressure, capacity, size, and related measurements shall be as shown on the drawings.
F. Connections Valves and Strainers: Shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the inlet and outlet of the valve.

2.7 BACKWATER VALVE

A. The backwater valve shall have a cast iron body, automatic thermoplastic type valve seat and flapper suited for water service. The flapper shall be slightly open during periods of non-operation. The pressure reducing valve shall meet ASME A112.14.1. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.
B. When the backwater valve is installed greater than 600 mm (24 inches) below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

2.8 BACKFLOW PREVENTERS

A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination.
B. The reduced pressure principle backflow prevention assembly shall be ASSE listed 1013 with full port OS&Y positive-seal resilient gate valves and an integral relief monitor switch. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade 4. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The checks and the relief valve shall be accessible for maintenance without removing the device from the line. An epoxy coated wye type strainer with flanged connections shall be installed on the inlet. Reduced pressure backflow preventers shall be installed in the following applications.
    1. Deionizers.
    2. Sterilizers.
    3. Stills.
    4. Dialysis, Deionized or Reverse Osmosis Water Systems.
    5. Water make up to heating systems, cooling tower, chilled water system, generators, and similar equipment consuming water.
    6. Water service entrance from loop system.
    7. Dental equipment.
    8. Power washer.
    9. Medical equipment.
    10. Process equipment.
    11. Autopsy, on each hot and cold water outlet at each table or sink.
    12. Reclaimed water systems.
C. The pipe applied or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from

the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.

1. Hose bibs and sinks with threaded outlets.
2. Disposers.
3. Showers (telephone/handheld type).
4. Hydrotherapy units.
5. All kitchen equipment, if not protected by air gap.
6. Ventilating hoods with wash down system.
7. Film processor.
8. Detergent system.
9. Fume hoods.
10. Glassware washers.
11. Service sinks (integral with faucet only).
12. Laundry tubs (integral with faucet only).

D. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:
   1. Hose bibbs and wall hydrants.

E. The pressure vacuum breaker shall be ASSE listed 1020. The main body shall be brass. The disc and O-ring seal shall be the elastomer type. The valve seat and disc float shall be the thermoplastic type. Tee handle or lever handle shut-off ball valves. Test cocks for testing and draining where freezing conditions occur. All materials shall be suitable for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Pressure vacuum breakers shall be installed in the following locations requiring continuous pressure and no backpressure including equipment with submerged inlet connections:
   1. Lawn Irrigation.

F. The laboratory faucet vacuum breaker shall be ASSE listed 1035. The main body shall be cast brass. Dual check valves with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to laboratory faucets for non-continuous pressure applications.

G. The double check backflow prevention assembly shall be ASSE listed 1015 and supply with full port, OS&Y, positive-seal, resilient gate valves. The main body and access cover shall be epoxy coated ductile iron conforming to ASTM A536 grade. The seat ring and check valve shall be the thermoplastic type suited for water service. The stem shall be stainless steel conforming to ASTM A276. The seat disc shall be the elastomer type suited for water service. The first and second check valve shall be accessible for maintenance without removing the device from the line. Double check valves shall be installed in the following location requiring continuous pressure subject to backpressure and backsiphonage conditions.
   1. Lawn Irrigation.
   2. Food Processing Equipment.
   3. Laundry equipment.

2.9 CHAINWHEELS

A. Valve chain wheel assembly with sprocket rim brackets and chain shall be constructed according to the following:
   1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   2. Attachment: For connection to valve stem.
   3. Sprocket rim with chain guides: //Ductile or cast iron// //Aluminum// //Bronze// of type and size required for valve with zinc coating.
   4. Chain: Hot dipped galvanized steel of size required to fit sprocket rim.

2.10 THERMOSTATIC MIXING VALVES

A. Automatic Water Temperature Control Mixing Valves:
   1. Application: Gang plumbing fixtures point-of-use when no other mixing at fixtures occurs.
   2. Standard: ASSE 1069.
   3. Pressure Rating: 861 kPa (125 psig).
   4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
   5. Connections: Threaded union or soldered inlets and outlet.
   6. Thermometers shall be provided to indicate mixed water temperature.
   7. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.5 gpm maximum.
   8. Provide a high temperature alarm device to detect mixing valve failure.

B. Water Temperature Limiting Devices:
   1. Application: Single plumbing fixture point-of-use such as sinks or lavatories.
   2. Standard: ASSE 1070.
   3. Pressure Rating: 861 kPa (125 psig).
   4. Type: Thermostatically controlled water mixing valve set at 43 degrees C (110 degrees F).
   5. Connections: Threaded union, compression or soldered inlets and outlet.
   6. Upon cold water supply failure the hot water flow shall automatically be reduced to 0.2 gpm maximum.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
C. Threads on valve and mating pipe shall be examined for form and cleanliness.
D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
E. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
D. Valves shall be installed in a position to allow full stem movement.
E. Install chain wheels on operators for valves NPS 100 mm or DN100 (4 inches) and larger and more than 3.6 m (12 feet) above floor. Chains shall be extended to 1524 mm (60 inches) above finished floor.
F. Check valves shall be installed for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.
G. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.
   1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

H. Install pressure gages on outlet of backflow preventers.
I. Do not install bypass piping around backflow preventers.
J. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets.
   1. Install thermometers if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.
K. If an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no cost to the Government.

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Calibrated balancing valves.
   2. Master, thermostatic, water mixing valves.
   3. Manifold, thermostatic, water-mixing-valve assemblies.
B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.

3.4 ADJUSTING

A. Valve packing shall be adjusted or replaced after piping systems have been tested and put into service but before final adjusting and balancing. Valves shall be replaced if persistent leaking occurs.
B. Set field-adjustable flow set points of balancing valves and record data. Ensure recorded data represents actual measured or observed conditions. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.
D. Testing and adjusting of balancing valves shall be performed by an independent NEBB Accredited Test and Balance Contractor. A final settings and flow report shall be submitted to the Engineer.

3.6 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer’s technical representative for four [4] hours to instruct personnel in operation and maintenance of the system.

END OF SECTION

SECTION 221100

FACILITY WATER DISTRIBUTION

PART 1 - GENERAL

1.1 DESCRIPTION

A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.
B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

A. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
B. American Society of Mechanical Engineers (ASME):
A13.1-2007 (R2013)..... Scheme for Identification of Piping Systems
B16.3-2011..... Malleable Iron Threaded Fittings: Classes 150 and 300
B16.9-2012..... Factory-Made Wrought Butt-welding Fittings
B16.11-2011..... Forged Fittings, Socket-Welding and Threaded
B16.12-2009 (R2014)..... Cast Iron Threaded Drainage Fittings
B16.15-2013 ..... Cast Copper Alloy Threaded Fittings: Classes 125 and 250
B16.18-2012..... Cast Copper Alloy Solder Joint Pressure Fittings
B16.22-2013..... Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
B16.24-2011..... Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500
B16.51-2013..... Copper and Copper Alloy Press-Connect Fittings
ASME Boiler and Pressure Vessel Code -
BPVC Section IX-2015..... Welding, Brazing, and Fusing Qualifications
C. American Society of Sanitary Engineers (ASSE):
1010-2004 ..... Performance Requirements for Water Hammer Arresters
D. American Society for Testing and Materials (ASTM):
A47/A47M-1999 (R2014) ..... Standard Specification for Ferritic Malleable Iron Castings
A53/A53M-2012 ..... Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
A183-2014..... Standard Specification for Carbon Steel Track Bolts and Nuts
A269/A269M-2014e1 ..... Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
A312/A312M-2015 ..... Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
A403/A403M-2014 ..... Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings
A536-1984 (R2014)..... Standard Specification for Ductile Iron Castings
A733-2013..... Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
B32-2008 (R2014)..... Standard Specification for Solder Metal
B43-2014..... Standard Specification for Seamless Red Brass Pipe, Standard Sizes
B61-2008 (R2013)..... Standard Specification for Steam or Valve Bronze Castings
B62-2009..... Standard Specification for Composition Bronze or Ounce Metal Castings

B75/B75M-2011 ..... Standard Specification for Seamless Copper Tube
B88-2014 ..... Standard Specification for Seamless Copper Water Tube
B584-2014 ..... Standard Specification for Copper Alloy Sand Castings for General Applications
B687-1999 (R2011) ..... Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
C919-2012 ..... Standard Practice for Use of Sealants in Acoustical Applications
D1785-2012 ..... Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
D2000-2012 ..... Standard Classification System for Rubber Products in Automotive Applications
D2564-2012 ..... Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems
D2657-2007 ..... Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings
D2855-1996 (R2010) ..... Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings
D4101-2014 ..... Standard Specification for Polypropylene Injection and Extrusion Materials
E1120-2008 ..... Standard Specification for Liquid Chlorine
E1229-2008 ..... Standard Specification for Calcium Hypochlorite
F2389-2010 ..... Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
F2620-2013 ..... Standard Practice for Heat Fusion Joining of Polyethylene Pipe and Fittings
F2769-2014 ..... Standard Specification for Polyethylene of Raised Temperature (PE-RT) Plastic Hot and Cold-Water Tubing and Distribution Systems

E. American Water Works Association (AWWA):
C110-2012 ..... Ductile-Iron and Gray-Iron Fittings
C151-2009 ..... Ductile Iron Pipe, Centrifugally Cast
C153-2011 ..... Ductile-Iron Compact Fittings
C203-2008 ..... Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
C213-2007 ..... Fusion-Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines
C651-2014 ..... Disinfecting Water Mains

F. American Welding Society (AWS):
A5.8M/A5.8-2011-AMD1 ..... Specification for Filler Metals for Brazing and Braze Welding

G. New York State Codes Council:
NYSBC-2010 ..... New York State Building Code
NYSPC-2010 ..... New York State Plumbing Code
NYFGC-2010……. New York Fuel Gas Code

H. Manufacturers Specification Society (MSS):
SP-58-2009 ..... Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation
SP-72-2010a ..... Ball Valves with Flanged or Butt-Welding Ends for General Service
SP-110-2010 ..... Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

I. NSF International (NSF):
14-2015 ..... Plastics Piping System Components and Related Materials
61-2014a ..... Drinking Water System Components – Health Effects
372-2011 ..... Drinking Water System Components – Lead Content

J. Plumbing and Drainage Institute (PDI):
PDI-WH 201-2010 ..... Water Hammer Arrestors

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. Information and material submitted under this section shall be marked “SUBMITTED UNDER SECTION 22 11 00, FACILITY WATER DISTRIBUTIONS”, with applicable paragraph identification.
C. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
   1. All items listed in Part 2 - Products.
D. Complete operating and maintenance manuals including wiring diagrams, technical data sheets and information for ordering replacement parts:
   1. Include complete list indicating all components of the systems.
   2. Include complete diagrams of the internal wiring for each item of equipment.
   3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.

1.5 QUALITY ASSURANCE

A. A certificate shall be submitted prior to welding of steel piping showing the Welder’s certification. The certificate shall be current and no more than one year old. Welder’s qualifications shall be in accordance with ASME BPVC Section IX.
B. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be by the same manufacturer as the groove components.
C. All pipe, couplings, fittings, and specialties shall bear the identification of the manufacturer and any markings required by the applicable referenced standards.

1.6 SPARE PARTS

A. For mechanical press-connect fittings; provide tools required for each pipe size used at the facility.

1.7 AS-BUILT DOCUMENTATION

A. Submit manufacturer’s literature and data updated to include submittal review comments and any equipment substitutions.
B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be in electronic version on compact disc or DVD. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices shall be included. A list of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.
C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version 2010 provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the ‘third party testing company’ requirement.
D. Certification documentation shall be provided to the Engineer 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certificate if applicable that all results of tests were within limits specified. If a certificate is not available, all documentation shall be on the Certifier’s letterhead.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Material or equipment containing a weighted average of greater than 0.25 percent lead are prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.
B. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended.

2.2 UNDERGROUND WATER SERVICE CONNECTIONS TO BUILDINGS

A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building and underground inside building, material to be the same for the size specified inside the building.
B. 75 mm (3 inch) Diameter and Greater: Ductile iron, AWWA C151, 2413 kPa (350 psig) pressure class, exterior bituminous coating, and cement lined. Bio-based materials shall be utilized when possible. Provide flanged and anchored connection to interior piping.
C. Under 75 mm (3 inch) Diameter: Copper tubing, ASTM B88, Type K, seamless, annealed. Fittings are as specified in paragraph “Above Ground (Interior) Water Piping”. Use brazing alloys, AWS A5.8M/A5.8, Classification BCuP.
D. Flexible Expansion Joint: Ductile iron with ball joints rated for 1725 kPa (250 psig) working pressure conforming to AWWA C153, capable of deflecting a minimum of 20 degrees in each direction. Flexible expansion joint size shall match the pipe size it is connected to and shall have the expansion capability designed as an integral part of the ductile iron ball castings. Pressure containing parts shall be lined with a minimum of 15 mils of fusion bonded epoxy conforming to the applicable requirements of AWWA C213 and shall be factory tested with a 1500 volt spark test. Flexible expansion joint shall have flanged connections conforming to AWWA C110. Bolts and nuts shall be 316 stainless steel and gaskets shall be neoprene. The flexible expansion fitting shall not expand or exert an axial thrust under internal water pressure. Provide piping joint restraints at each mechanical joint end connection and piping restraints at the penetration of the building wall. The restraints shall be provided to address the developed thrust at the change of piping direction.

2.3 ABOVE GROUND (INTERIOR) WATER PIPING

A. Pipe: Copper tube, ASTM B88, Type K or L, drawn. For pipe 150 mm (6 inches) and larger, stainless steel, ASTM A312, schedule 40 shall be used.
B. Fittings for Copper Tube:
    1. Wrought copper or bronze castings conforming to ASME B16.18 and B16.22. Unions shall be bronze, MSS SP-72, MSS SP-110, solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
    2. Grooved fittings, 50 to 150 mm (2 to 6 inch) wrought copper ASTM B75/B75M C12200, 125 to 150 mm (5 to 6 inch) bronze casting ASTM B584, C84400. Mechanical grooved couplings, 2070 kpa (300 psig) minimum ductile iron, ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.
    3. Mechanical press-connect fittings for copper pipe and tube shall conform to the material and sizing requirements of ASME B16.51, NSF 61 approved, 50 mm (2 inch) size and smaller mechanical press-connect fittings, double pressed type, with EPDM (ethylene propylene diene monomer) non-toxic synthetic rubber sealing elements and un-pressed fitting identification feature.
    4. Mechanically formed tee connection: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall ensure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in

a single process to provide free flow where the branch tube penetrates the fitting. Braze joints.
5. Flanged fittings, bronze, class 150, solder-joint ends conforming to ASME B16.24.

C. Fittings for Stainless Steel:
1. Stainless steel butt-welded fittings, Type 316, Schedule 10, conforming to ASME B16.9.
2. Grooved fittings, stainless steel, Type 316, Schedule 40, conforming to ASTM A403/A403M. Segmentally fabricated fittings are not allowed. Mechanical grooved couplings, ductile iron, 4138 kPa (600 psig), ASTM A536 Grade 448-310-12 (Grade 65-45-12), or malleable iron, ASTM A47/A47M Grade 22410 (Grade 32510) housing, with EPDM gasket, steel track head bolts, ASTM A183, coated with copper colored alkyd enamel.

D. Adapters: Provide adapters for joining pipe or tubing with dissimilar end connections.
E. Solder: ASTM B32 alloy type Sb5, HA or HB. Provide non-corrosive flux.
F. Brazing alloy: AWS A5.8M/A5.8, brazing filler metals shall be BCuP series for copper to copper joints and BAg series for copper to steel joints.

2.4 EXPOSED WATER PIPING
A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
1. Pipe: ASTM B43, standard weight.
2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish.
3. Nipples: ASTM B687, Chromium-plated.
4. Unions: MSS SP-72, MSS SP-110, brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.

2.5 STRAINERS
A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.
B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.
C. Body: Less than 75 mm (3 inches), brass or bronze; 75 mm (3 inches) and greater, cast iron or semi-steel.

2.6 DIELECTRIC FITTINGS
A. Provide dielectric couplings or unions between pipe of dissimilar metals.

2.7 WATER HAMMER ARRESTER
A. Closed copper tube chamber with permanently sealed 413 kPa (60 psig) air charge above a Double O-ring piston. Two high heat Buna-N 0-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010. Access shall be provided where devices are concealed within partitions or above ceilings. Size and install in accordance with PDI-WH 201 requirements. Provide water hammer arrestors at:
1. All solenoid valves.
2. All groups of two or more flush valves.
3. All quick opening or closing valves.
4. All medical washing equipment.

PART 3 - EXECUTION

3.1 INSTALLATION
A. General: Comply with the International Plumbing Code and the following:
1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.

2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to remove burrs and a clean smooth finish restored to full pipe inside diameter.
3. All pipe runs shall be laid out to avoid interference with other work/trades.
4. Install union and shut-off valve on pressure piping at connections to equipment.
5. Pipe Hangers, Supports and Accessories:
    a. All piping shall be supported per the IPC, H-18-8 Seismic Design Handbook, MSS SP-58, and SMACNA as required.
    b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
    c. Floor, Wall and Ceiling Plates, Supports, Hangers:
        1) Solid or split un-plated cast iron.
        2) All plates shall be provided with set screws.
        3) Pipe Hangers: Height adjustable clevis type.
        4) Adjustable Floor Rests and Base Flanges: Steel.
        5) Concrete Inserts: "Universal" or continuous slotted type.
        6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
        7) Pipe Hangers and Riser Clamps: Malleable iron or carbon steel. Pipe Hangers and riser clamps shall have a copper finish when supporting bare copper pipe or tubing.
        8) Rollers: Cast iron.
        9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
        10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (minimum) metal protection shield centered on and welded to the hanger and support. The shield thickness and length shall be engineered and sized for distribution of loads to preclude crushing of insulation without breaking the vapor barrier. The shield shall be sized for the insulation and have flared edges to protect vapor-retardant jacket facing. To prevent the shield from sliding out of the clevis hanger during pipe movement, center-ribbed shields shall be used.
        11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6.1 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
        12) With the installation of each flexible expansion joint, provide piping restraints for the upstream and downstream section of the piping at the flexible expansion joint. Provide calculations supporting the restraint length design and type of selected restraints. Restraint calculations shall be based on the criteria from the manufacturer regarding their restraint design.
6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
7. Penetrations:
    a. Firestopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke, and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the firestopping materials.
    b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS. Bio-based materials shall be utilized when possible.
    c. Acoustical sealant: Where pipes pass through sound rated walls, seal around the pipe penetration with an acoustical sealant that is compliant with ASTM C919.
8. Mechanical press-connect fitting connections shall be made in accordance with the manufacturer’s installation instructions. The tubing shall be fully inserted into the fitting and the tubing marked at the shoulder of the fitting. The fitting alignment shall be checked against the mark on the tubing to assure the tubing is fully engaged (inserted) in the fitting. Ensure

the tube is completely inserted to the fitting stop (appropriate depth) and squared with the fitting prior to applying the pressing jaws onto the fitting. The joints shall be pressed using the tool(s) approved by the manufacturer. Minimum distance between fittings shall be in accordance with the manufacturer's requirements. When the pressing cycle is complete, visually inspect the joint to ensure the tube has remained fully inserted, as evidenced by the visible insertion mark.

B. Domestic Water piping shall conform to the following:
   1. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
   2. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.

3.2 TESTS

A. General: Test system either in its entirety or in sections. Submit testing plan to the Engineer 10 working days prior to test date.
B. Potable Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 1035 kPa (150 psig) gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested. Pressure gauge shall have 1 psig increments.
C. Re-agent Grade Water Systems: Fill system with water and maintain hydrostatic pressure of 1380 kPa (200 psig) gage during inspection and prove tight.
D. All Other Piping Tests: Test new installed piping under 1-1/2 times actual operating conditions and prove tight.
E. The test pressure shall hold for the minimum time duration required by the applicable plumbing code or authority having jurisdiction.

3.3 STERILIZATION

A. After tests have been successfully completed, thoroughly flush and sterilize the interior domestic water distribution system in accordance with AWWA C651.
B. Use liquid chlorine or hypochlorite for sterilization.

3.5 DEMONSTRATION AND TRAINING

A. Provide services of manufacturer's technical representative for four [4] hours to instruct personnel in operation and maintenance of the system.

END OF SECTION

SECTION 232113

HYDRONIC PIPING
(ASTM POTABLE PEX DISTRIBUTION SYSTEM)

PART 1: GENERAL

1.01 SUMMARY

A. Section Includes: Flexible pre-insulated potable pipe distribution system that incorporates crosslinked polyethylene (PEX-a) service tubing with a self-regulating heat trace cable for potable hot and cold fluid distribution systems.

1.02 REFERENCES

A. General Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by the issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

B. ASTM International

1. ASTM F876 Standard Specification for Crosslinked Polyethylene (PEX) Tubing
2. ASTM F877 Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems

C. American Standards Institute (ANSI)/National Sanitation Foundation (NSF)

1. ANSI/NSF 61 Drinking Water System Components – Health Effects
2. ANSI/NSF 14 Plastics Piping System Components and Related Materials

D. Canadian Standards Association (CSA)

1. CSA B137.5 Standard Specification for Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications

E. Canadian Commission on Building and Fire Codes (CCBFC)

1. National Building Code of Canada, Part 7: National Plumbing Code (NPC) of Canada

F. International Code Council (ICC)

1. International Plumbing Code (IPC)

G. International Association of Plumbing and Mechanical Officials (IAPMO)

1. Uniform Plumbing Code (UPC)

H. National Association of Plumbing, Heating and Cooling Contractors (NAPHCC)

1. National Standard Plumbing Code (NSPC)

1.03 SYSTEM DESCRIPTION

A. Design Requirements: The potable PEX-a service tubing is USA manufactured and tested in accordance with ASTM F876, ASTM F877, CSA B137.5 and NSF-pw. The potable PEX-a service tubing has hydrostatic ratings in accordance with the temperatures and pressures listed in the ASTM standard. The hydrostatic ratings are:

1. 200 degrees F (93 degrees C) at 80 PSI (551 kPa)

2. 180 degrees F (82 degrees C) at 100 PSI (689 kPa)
3. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa)

B. Performance Requirements: Provide a pre-insulated potable distribution system that is USA manufactured, fabricated and installed to comply with regulatory agencies and authorities with jurisdiction, and that maintains performance criteria stated by the tubing manufacturer without defects, damage or failure.

1. Show compliance with ASTM F876 for Crosslinked Polyethylene (PEX) Tubing.
2. Show compliance with ASTM F877 for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems.
3. Show compliance with NSF 61 regarding Drinking Water System Components.
4. Show compliance with CSA B137.5 regarding Crosslinked Polyethylene (PEX) Tubing Systems for Pressure Applications.
5. Show compliance with ASTM F1960 regarding Cold Expansion Fittings with PEX Reinforcing Rings for Use with Cross-linked Polyethylene (PEX) Tubing.
6. Show compliance with NSF-pw to indicate that the product complies with the Health-effects Requirements of NSF/ANSI Standard 61 for Materials Designed for Contact with Potable Water.

1.04 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit manufacturer's product submittal data and installation instructions.

C. Shop Drawings: Provide installation drawings indicating: piping layout, size dimension by installation segment, vault locations, support fixtures and schedules with all details required for installation of the system.

D. Samples: Submit selection and verification samples of piping.

E. Quality Assurance/Control Submittals

1. Test Reports: Upon request, submit test reports from recognized testing laboratories.
2. Submit the following documentation.
    a. Manufacturer's certificate stating that products comply with specified requirements
    b. Manufacturer's flow schedule for the distribution system
    c. Documentation that the installer is trained to install the manufacturer's products

F. Closeout Submittals: Submit the following documents.

1. Warranty documents specified herein
2. Operation and maintenance data
3. Manufacturer's field reports specified herein
4. Final as-built piping layout drawing

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Use an installer with demonstrated experience on projects of similar size and complexity and possessing documentation proving familiarization training by the tubing manufacturer.

B. Regulatory Requirements and Approvals:

1. Ensure the pre-insulated potable PEX-a piping distribution system complies with all applicable codes and regulations.

C. Certifications: Provide letters of certification indicating:

1. Installer uses skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades person.

D. Pre-installation Meetings:

1. Verify project requirements, excavation conditions, system performance requirements, manufacturer's installation instructions and warranty requirements.
2. Review project construction timeline to ensure compliance or discuss modifications as required.
3. Interface with other trade representatives to verify areas of responsibility.
4. Establish the frequency and construction phase the project engineer intends for site visits and inspections by the tubing manufacturer's representative.

1.06 DELIVERY, STORAGE and HANDLING

A. General: Comply with Division 1 Product Requirement Section.

B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

C. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

D. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1. Store pre-insulated potable piping coils under cover to prevent dirt or foreign material from entering the service tubing.
2. Do not expose the potable PEX-a service tubing to direct sunlight for more than 30 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

1.07 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty: Submit, for owner's acceptance, USA manufacturer's standard 5-year warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights owner may have under contract documents.

1. Warranty covers the repair or replacement of any piping or fittings proven defective.
2. Warranty may transfer to subsequent owners.
3. The most recent limited warranty published by the manufacturer takes precedence at time of installation.

1.08 SYSTEM STARTUP

A. Instruct Owner's personnel about operation and maintenance of installed system. Provide manufacturer's installation, operation and maintenance instructions for installed components within the system.

PART 2: PRODUCTS

2.01 ASTM POTABLE PEX DISTRIBUTION SYSTEM with SELF-REGULATING HEATING CABLE

A. Acceptable Manufacturers and Products

1. Ecoflex Potable Plus as manufactured by Uponor, Inc.

2.02 PRODUCT SUBSTITUTIONS

A. Alternative equipment manufacturers must submit required data for all mechanical and engineering data revisions for an equivalent ASTM piping system for approval prior to ordering and installation of the product.

2.03 ASTM POTABLE PEX DISTRIBUTION SYSTEM MATERIALS

A. Service Tubing:

1. Material: Crosslinked polyethylene (PEX) is manufactured to PEX-a or Engel-method standard and NSF-certified SDR-9.
2. Material Standard: Materials are manufactured in accordance with ASTM F876, F877, CSA B137.5 and NSF-pw.
3. Pressure Ratings: Hydrostatic design and pressure ratings are in accordance with the ASTM standard.
4. Nominal Inside Diameter: Provide tubing with nominal inside diameter in accordance with ASTM F876, as indicated. Note: Numbers in brackets are the metric equivalent pipe size.
    a. 1 inch [25mm]
    b. 1¼ inch [32mm]
    c. 1½ inch [40mm]
    d. 2 inch [50mm]
    e. 3 inch [75mm]

B. Outer Jacket

1. Material: Corrugated seamless high-density polyethylene (HDPE)
2. The HDPE jacket completely encompasses and protects the insulation from moisture and damage.
3. Outer jacket will be extruded directly over the insulation and is flexible.
4. Minimum Bend Radius:
    a. 1-inch pre-insulated potable tubing with 5.5-inch [140mm] jacket has a bend radius of 10 inches [254mm].
    b. 1¼-inch pre-insulated potable tubing with 5.5-inch [140mm] jacket has a bend radius of 12 inches [304mm].
    c. 1½-inch pre-insulated potable tubing with 6.9-inch [175mm] jacket has a bend radius of 16 inches [406mm].

d. 2-inch pre-insulated potable tubing with 6.9-inch [175mm] jacket has a bend radius of 18 inches [457mm].

e. 3-inch pre-insulated potable tubing with 7.9-inch [200mm] jacket has a bend radius of 32 inches [812mm].

5. The outer jacket shall contain 2 percent carbon black, finely divided and thoroughly dispersed to provide protection from UV degradation.

C. Insulation

1. The insulation will be layered expanded cross-linked water-resistant polyethylene closed-cell foam.

2. All seams of the insulation will be sealed.

3. Insulation shall not be bonded to the service tubing.

D. End Seals

1. The piping manufacturer will supply all EPDM rubber end caps with water-stop seal.

2. EPDM rubber end caps are to be installed on each end prior to connecting the service pipes and insulating the field joints.

3. The EPDM end caps will seal onto the tubing and outer jacket forming a watertight seal.

E. Cold Expansion Fittings for PEX-a Service Tubing

1. For system compatibility, use fittings offered by the tubing manufacturer.

2. Fittings must comply with the performance requirements of ASTM F877.

3. Fittings are to be manufactured in accordance with ASTM F1960.

4. The fitting assembly consists of a barbed adapter and an applicable-sized PEX ring.

5. All buried fittings will be installed, insulated, and sealed in accordance with the instructions of the piping manufacturer.

F. Compression Fittings for PEX-a Service Tubing

1. For system compatibility, use fittings offered by the tubing manufacturer.

2. Fittings are to be manufactured from dezincification-resistant brass and lead-free brass.

3. The fitting assembly must comply with performance requirements of ASTM F877.

4. Fittings will consist of a compression fitting with a coupling sleeve, a fitting body insert with o-ring(s) and a bolt and nut.

5. All buried fittings will be installed, insulated, and sealed in accordance with the piping manufacturer's instructions.

6. Male NPT thread for each compression fitting is shown below.

a. 1-inch PEX compression fitting has 1-inch male NPT thread.

b. 1¼-inch PEX compression fitting has 1¼-inch male NPT thread.

c. 1½-inch PEX compression fitting has 1½-inch male NPT thread.

d. 2-inch PEX compression fitting has 2-inch male NPT thread.

e. 3-inch PEX compression fitting has 2½-inch male NPT thread.

7. All transition fittings connecting to the compression fittings will be manufactured of

dezincification-resistant brass.

2.04 PIPE AND FITTING IDENTIFICATION

A. The pipe shall be marked in accordance with the standards to which it is manufactured.

B. Color identification by the use of stripes on pipe to identify pipe service shall be optional. If used, stripes or colored exterior pipe product shall be blue for potable water, green for wastewater/sewage, or purple for reclaimed water. [Optional]

C. Tracing wire shall be placed parallel and 18 inches above, but separate from, the pipe and shall be 10 AWG. [Specifier can change this to preferred material or method; all pipes should have a locatable methodology.]

D. Marking tape shall be approved by the engineer and placed between 12 and 18 inches above the crown of the pipe. [Optional]

2.05 ACCESSORIES

E. Use accessories associated with the installation of the ASTM Ecoflex Potable PEX distribution piping system as recommended by or available from the manufacturer.

F. Insulation Kits

1. Insulation kits will be manufactured of ABS shells or HDPE sleeves, will feature equal thickness of closed-cell PEX insulation as the pipe, and sealed watertight.

G. Connection Vaults

1. The piping manufacturer will provide the connection vaults when required by the project construction.

2. Connection vaults will be constructed of rotationally molded composite polyethylene and PE foam, providing a structurally sound and thermally insulated chamber.

3. Heat shrink seals as provided by the tubing manufacturer will be installed to prevent introduction of water into the vault.

D. Anchors

1. The project engineer will determine the use of anchors, if required, within the distribution system.

PART 3: EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including:

1. Uponor Pre-insulated Pipe Systems Design and Installation Manual, current edition

3.02 EXAMINATION

A. Site Verification of Conditions

1. Verify that site conditions are acceptable for installation of the pre-insulated potable PEX-a piping distribution system.

2. Do not proceed with installation until unacceptable conditions are corrected.

3.03 INSTALLATION

A. Below-grade Installation

1. Potable pre-insulated piping will be installed in accordance with manufacturer's recommendations and the details as shown on the contract drawings.
2. The system will be installed with the fewest number of underground joints as possible.
3. The system does not require expansion loops, expansion joints or compensators of any type.
4. An EPDM rubber end cap will be applied at all terminations of the pre-insulated potable piping system, including all fitting locations, to form a watertight seal.
5. All buried fittings will be installed, insulated and sealed in accordance with the instructions of the piping manufacturer.
6. Connection Vaults or Insulation Kits are required for all below-grade installations.

B. Backfill

1. The pre-insulated potable piping system will be backfilled with clean sand material.
    a. Minimum vertical distance from the bottom of the tubing to the trench floor is 4 inches [100mm].
    b. Minimum lateral distance from the side of the tubing to the trench wall is 6 inches [150mm].
    c. Install a minimum of 12 inches [300mm] of clean fill over the top of the pre-insulated potable piping.
2. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches [50mm] in diameter.

3.04 FIELD QUALITY CONTROL

A. Site Tests

1. To ensure system integrity, pressure-test the tubing before and during backfilling of the piping.
2. The service tubing will be air tested at 1½ times the operating pressure for a minimum of 2 hour prior to system burial. Test shall be performed in the presence of the engineer and local inspector. Test shall be repeated if necessary until final approval of system is obtained.

3.05 CLEANING

A. Remove temporary coverings and protection of adjacent work areas.

B. Repair or replace damaged installed products.

C. All piping shall be thoroughly and completely flushed and disinfected in strict compliance with procedures established by AWWA and acceptable to the New York State Health Department and as follows:

1. Flush system with clean potable water until dirty water does not appear at outlets.
2. Fill system with a water/chlorine solution of 50 ppm for 24 hours (or 200 ppm for 3 hours).
3. After standing time, flush again with clean potable water until chlorine is purged.
4. Perform bacteriological examination (by certified inspection agency). Repeat the process if tests are unsatisfactory.

D. Remove construction debris from project site and legally dispose of debris.

3.06 DEMONSTRATION

A. Demonstrate operation of the ASTM Potable PEX piping distribution system to Owner's personnel.

3.07 PROTECTION

A. Protect installed work from damage caused by subsequent construction activity on the site.

END OF SECTION

SECTION 260500

ELECTRIC WORK

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 02200.

B. Cast-In-Place Concrete: Section 03300.

1.02 QUALITY ASSURANCE

A. Qualifications: The persons performing the Work of this Section and their supervisor shall be personally experienced in electrical work and shall have been regularly performing such work for a minimum of 3 years.

B. UL Listing: Equipment and materials, for which Underwriters' Laboratories, Inc. (UL) provides product listing service, shall be listed and bear the listing mark.

C. Underwriter's Certificate: A New York Board of Fire Underwriters inspection or certificate is not required.

D. Qualifications For Products Other Than Those Specified:
At the time of submission provide written notice to the Director of the intent to propose an “or equal” for products other than those specified. Make the “or equal” submission in a timely manner to allow the Director sufficient time to review the proposed product, perform inspections and witness test demonstrations.

E. Provide written certification from the manufacturer that the proposed products are compatible for use with all other equipment proposed for use for this system and meet all contract requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Raceways For Concealed Work: Rigid metal conduit, IMC or EMT.

B. Raceways For Exposed Work: Wiremold Co. Surface Metal Raceway Systems; Walker/Parkersburg Snap Cap Surface Metal Raceway Systems.

C. Conductors: Copper, insulated with Type RHW, THW, XHHW, THWN or THHN insulation rated 600 volts.

PART 3 EXECUTION

3.01 PREPARATION

A. Before installing any Work, lay out the proposed course for the conduits, stub locations, pullboxes, etc. and have same approved.

3.02 INSTALLATION

A. Install the Work in accordance with the requirements of the National Electrical Code.

B. Conduit System:

1. Use rigid ferrous metal conduit in all locations unless otherwise specified or indicated.

2. Conduits Entering Buildings: Conduit entrances into building shall be watertight.

3. Cleaning Conduits: Take precautions to prevent foreign matter from entering conduits during installation. After installation, clean conduits with tools designed for the purpose.

4. Jacking Conduits: Rigid ferrous metal conduit may be jacked under roads, parking lots, etc. Submit jacking details for approval.

5. Provide Additional Length to wire runs to allow wiring of future panel work.

C. Contractor will not be allowed to tie into adjacent electrical facilities or systems until the Director's Representative has reviewed and approved any/all connections.

END OF SECTION

SECTION 260511

REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section applies to all sections of Division 26.
B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, switchboards, switchgear, panelboards, motor control centers, generators, automatic transfer switches, and other items and arrangements for the specified items are shown on the drawings.
C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company's system, and obtain electric utility company approval for sizes and settings of these devices.
D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC. Aluminum conductors are prohibited.

1.2 MINIMUM REQUIREMENTS

A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

1.3 TEST STANDARDS

A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing that materials and equipment are listed, labeled, certified or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.
B. Definitions:
    1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
    2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
    3. Certified: Materials and equipment which:
        a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
        b. Are periodically inspected by a NRTL.
        c. Bear a label, tag, or other record of certification.

4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.
B. Product Qualification:
   1. Manufacturer's materials and equipment shall have been in satisfactory operation, on three installations of similar size and type as this project, for at least three years.
   2. The Government reserves the right to require the Contractor to submit a list of installations where the materials and equipment have been in operation before approval.
C. Service Qualifications: There shall be a permanent service organization maintained or trained by the manufacturer which will render satisfactory service to this installation within eight hours of receipt of notification that service is needed. Submit name and address of service organizations.

1.5 APPLICABLE PUBLICATIONS

A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

1.6 MANUFACTURED PRODUCTS

A. Materials and equipment furnished shall be of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available. Materials and equipment furnished shall be new, and shall have superior quality and freshness.
B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.
C. Equipment Assemblies and Components:
   1. Components of an assembled unit need not be products of the same manufacturer.
   2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
   3. Components shall be compatible with each other and with the total assembly for the intended service.
   4. Constituent parts which are similar shall be the product of a single manufacturer.
D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

A. Where the Owner or the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

1.8 MATERIALS AND EQUIPMENT PROTECTION

A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
   1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
   2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum-cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
   3. Damaged equipment shall be repaired or replaced, as determined by the Engineer.
   4. Painted surfaces shall be protected with factory installed removable heavy kraft paper, sheet vinyl or equal.

5. Damaged paint on equipment shall be refinished with the same quality of paint and workmanship as used by the manufacturer so repaired areas are not obvious.

1.9 WORK PERFORMANCE

A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, NFPA 70E, OSHA Part 1910 subpart J – General Environmental Controls, OSHA Part 1910 subpart K – Medical and First Aid, and OSHA Part 1910 subpart S – Electrical, in addition to other references required by contract.
B. Job site safety and worker safety is the responsibility of the Contractor.
C. Electrical work shall be accomplished with all affected circuits or equipment de-energized. When an electrical outage cannot be accomplished in this manner for the required work, the following requirements are mandatory:
   1. Electricians must use full protective equipment (i.e., certified and tested insulating material to cover exposed energized electrical components, certified and tested insulated tools, etc.) while working on energized systems in accordance with NFPA 70E.
   2. Before initiating any work, a job specific work plan must be developed by the Contractor with a peer review conducted and documented by the Engineer. The work plan must include procedures to be used on and near the live electrical equipment, barriers to be installed, safety equipment to be used, and exit pathways.
   3. Work on energized circuits or equipment cannot begin until prior written approval is obtained from the Engineer.
D. For work that affects existing electrical systems, arrange, phase and perform work to assure minimal interference with normal functioning of the facility.
E. New work shall be installed and connected to existing work neatly, safely and professionally. Disturbed or damaged work shall be replaced or repaired to its prior conditions, as required by Section 01 00 00, GENERAL REQUIREMENTS.
F. Coordinate location of equipment and conduit with other trades to minimize interference.

1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

A. Equipment location shall be as close as practical to locations shown on the drawings.
B. Working clearances shall not be less than specified in the NEC.
C. Inaccessible Equipment:
   1. Where the Government determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Government.
   2. "Readily accessible” is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.
D. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company’s system shall conform to the electric utility company's requirements. Coordinate fuses, circuit breakers and relays with the electric utility company’s system, and obtain electric utility company approval for sizes and settings of these devices.

1.11 EQUIPMENT IDENTIFICATION

A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as switchboards and switchgear, panelboards, cabinets, motor controllers, fused and non-fused safety switches, generators, automatic transfer switches, separately enclosed circuit breakers, individual breakers and controllers in switchboards, switchgear and motor control assemblies, control devices and other significant equipment.
B. Identification signs for Normal Power System equipment shall be laminated black phenolic resin with a white core with engraved lettering. Identification signs for Essential Electrical System (EES) equipment, as defined in the NEC, shall be laminated red phenolic resin with a white core with engraved lettering. Lettering shall be a minimum of 12 mm (1/2 inch) high. Identification

signs shall indicate equipment designation, rated bus amperage, voltage, number of phases, number of wires, and type of EES power branch as applicable. Secure nameplates with screws.

C. Install adhesive arc flash warning labels on all equipment as required by NFPA 70E. Label shall show specific and correct information for specific equipment based on its arc flash calculations. Label shall show the followings:
   1. Nominal system voltage.
   2. Arc flash boundary (inches).
   3. Available arc flash incident energy at the corresponding working distance (calories/cm2).
   4. Required PPE category and description.
   5. Limited approach distance (inches), restricted approach distance (inches).
   6. Equipment/bus name, date prepared, and manufacturer name and address.

1.12 SUBMITALS

A. Submit to the Engineer in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
B. The Government's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
C. All submittals shall include six copies of adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Government to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
D. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
   1. Mark the submittals, "SUBMITTED UNDER SECTION_____".
   2. Submittals shall be marked to show specification reference including the section and paragraph numbers.
   3. Submit each section separately.
E. The submittals shall include the following:
   1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.
   2. Elementary and interconnection wiring diagrams for communication and signal systems, control systems, and equipment assemblies. All terminal points and wiring shall be identified on wiring diagrams.
   3. Parts list which shall include information for replacement parts and ordering instructions, as recommended by the equipment manufacturer.
F. Maintenance and Operation Manuals:
   1. Submit as required for systems and equipment specified in the technical sections. Furnish in hardcover binders or an approved equivalent.
   2. Inscribe the following identification on the cover: the words "MAINTENANCE AND OPERATION MANUAL," the name and location of the system, material, equipment, building, name of Contractor, and contract name and number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the material or equipment.
   3. Provide a table of contents and assemble the manual to conform to the table of contents, with tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in.
   4. The manuals shall include:
      a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
      b. A control sequence describing start-up, operation, and shutdown.
      c. Description of the function of each principal item of equipment.
      d. Installation instructions.

e. Safety precautions for operation and maintenance.
f. Diagrams and illustrations.
g. Periodic maintenance and testing procedures and frequencies, including replacement parts numbers.
h. Performance data.
i. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare and replacement parts, and name of servicing organization.
j. List of factory approved or qualified permanent servicing organizations for equipment repair and periodic testing and maintenance, including addresses and factory certification qualifications.

G. Approvals will be based on complete submission of shop drawings, manuals, test reports, certifications, and samples as applicable.
H. After approval and prior to installation, furnish the Engineer with one sample of each of the following:
1. A minimum 300 mm (12 inches) length of each type and size of wire and cable along with the tag from the coils or reels from which the sample was taken. The length of the sample shall be sufficient to show all markings provided by the manufacturer.
2. Each type of conduit coupling, bushing, and termination fitting.
3. Conduit hangers, clamps, and supports.
4. Duct sealing compound.
5. Each type of receptacle, toggle switch, lighting control sensor, outlet box, manual motor starter, device wall plate, engraved nameplate, wire and cable splicing and terminating material, and branch circuit single pole molded case circuit breaker.

1.13 SINGULAR NUMBER

A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

1.15 ACCEPTANCE CHECKS AND TESTS

A. The Contractor shall furnish the instruments, materials, and labor for tests.
B. Where systems are comprised of components specified in more than one section of Division 26, the Contractor shall coordinate the installation, testing, and adjustment of all components between various manufacturer’s representatives and technicians so that a complete, functional, and operational system is delivered to the Government.
C. When test results indicate any defects, the Contractor shall repair or replace the defective materials or equipment, and repeat the tests. Repair, replacement, and retesting shall be accomplished at no additional cost to the Government.

1.16 WARRANTY

A. All work performed and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Contracting Officer for the Government.

1.17 INSTRUCTION

A. Instruction to designated Government personnel shall be provided for the particular equipment or system as required in each associated technical specification section.
B. Furnish the services of competent and factory-trained instructors to give full instruction in the adjustment, operation, and maintenance of the specified equipment and system, including pertinent safety requirements. Instructors shall be thoroughly familiar with all aspects of the installation, and shall be factory-trained in operating theory as well as practical operation and maintenance procedures.
C. A training schedule shall be developed and submitted by the Contractor and approved by the Engineer at least 30 days prior to the planned training.

PART 2 - PRODUCTS (NOT USED)
PART 3 - EXECUTION (NOT USED)

END OF SECTION

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS & CABLES

PART 1 – GENERAL

1.1 DESCRIPTION
A. This section specifies the furnishing, installation, connection, and testing of the electrical conductors and cables for use in electrical systems rated 600 V and below, indicated as cable(s), conductor(s), wire, or wiring in this section.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits for conductors and cables.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 FACTORY TESTS
A. Conductors and cables shall be thoroughly tested at the factory per NEMA to ensure that there are no electrical defects. Factory tests shall be certified.

1.5 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
   1. Shop Drawings:
      a. Submit sufficient information to demonstrate compliance with drawings and specifications.
      b. Submit the following data for approval:
         1) Electrical ratings and insulation type for each conductor and cable.
         2) Splicing materials and pulling lubricant.
   2. Certifications: Two weeks prior to final inspection, submit the following.
      a. Certification by the manufacturer that the conductors and cables conform to the requirements of the drawings and specifications.
      b. Certification by the Contractor that the conductors and cables have been properly installed, adjusted, and tested.

1.6 APPLICABLE PUBLICATIONS
A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are reference in the text by designation only.
B. American Society of Testing Material (ASTM):
   D2301-10 ..... Standard Specification for Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
   D2304-10 ..... Test Method for Thermal Endurance of Rigid Electrical Insulating Materials
   D3005-10 ..... Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape
C. National Electrical Manufacturers Association (NEMA):

WC 70-09 ..... Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy

D. National Fire Protection Association (NFPA):
70-11 ..... National Electrical Code (NEC)

E. Underwriters Laboratories, Inc. (UL):
44-10 ..... Thermoset-Insulated Wires and Cables
83-08 ..... Thermoplastic-Insulated Wires and Cables
467-07 ..... Grounding and Bonding Equipment
486A-486B-03 ..... Wire Connectors
486C-04 ..... Splicing Wire Connectors
486D-05 ..... Sealed Wire Connector Systems
486E-09 ..... Equipment Wiring Terminals for Use with Aluminum and/or Copper Conductors
493-07 ..... Thermoplastic-Insulated Underground Feeder and Branch Circuit Cables
514B-04 ..... Conduit, Tubing, and Cable Fittings

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Conductors and cables shall be in accordance with NEMA, UL, as specified herein, and as shown on the drawings.
B. All conductors shall be copper.
C. Single Conductor and Cable:
   1. No. 12 AWG: Minimum size, except where smaller sizes are specified herein or shown on the drawings.
   2. No. 8 AWG and larger: Stranded.
   3. No. 10 AWG and smaller: Solid; except shall be stranded for final connection to motors, transformers, and vibrating equipment.
   4. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

D. Direct Burial Cable: UF or USE cable.
E. Color Code:
   1. No. 10 AWG and smaller: Solid color insulation or solid color coating.
   2. No. 8 AWG and larger: Color-coded using one of the following methods:
      a. Solid color insulation or solid color coating.
      b. Stripes, bands, or hash marks of color specified.
      c. Color using 19 mm (0.75 inches) wide tape.
   4. For modifications and additions to existing wiring systems, color coding shall conform to the existing wiring system.
   5. Conductors shall be color-coded as follows:

208/120 V	Phase	480/277 V
Black	A	Brown
Red	B	Orange
Blue	C	Yellow
White	Neutral	Gray *
* or white with colored (other than green) tracer.		

   6. Lighting circuit “switch legs”, and 3-way and 4-way switch “traveling wires,” shall have color coding that is unique and distinct (e.g., pink and purple) from the color coding indicated above. The unique color codes shall be solid and in accordance with the NEC. Coordinate color coding in the field with the Engineer.
   7. Color code for isolated power system wiring shall be in accordance with the NEC.

2.2 SPLICES

A. Splices shall be in accordance with NEC and UL.
B. Above Ground Splices for No. 10 AWG and Smaller:
   1. Solderless, screw-on, reusable pressure cable type, with integral insulation, approved for copper and aluminum conductors.
   2. The integral insulator shall have a skirt to completely cover the stripped conductors.
   3. The number, size, and combination of conductors used with the connector, as listed on the manufacturer's packaging, shall be strictly followed.
C. Above Ground Splices for No. 8 AWG to No. 4/0 AWG:
   1. Compression, hex screw, or bolt clamp-type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
   2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
   3. Splice and insulation shall be product of the same manufacturer.
   4. All bolts, nuts, and washers used with splices shall be zinc-plated OR cadmium-plated steel.
D. Above Ground Splices for 250 kcmil and Larger:
   1. Long barrel “butt-splice” or “sleeve” type compression connectors, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
   2. Insulate with materials approved for the particular use, location, voltage, and temperature. Insulation level shall be not less than the insulation level of the conductors being joined.
   3. Splice and insulation shall be product of the same manufacturer.

2.3 CONNECTORS AND TERMINATIONS

A. Mechanical type of high conductivity and corrosion-resistant material, listed for use with copper and aluminum conductors.
B. Long barrel compression type of high conductivity and corrosion-resistant material, with minimum of two compression indents per wire, listed for use with copper and aluminum conductors.
C. All bolts, nuts, and washers used to connect connections and terminations to bus bars or other termination points shall be zinc-plated or cadmium-plated steel.

2.4 CONTROL WIRING

A. Unless otherwise specified elsewhere in these specifications, control wiring shall be as specified herein, except that the minimum size shall be not less than No. 14 AWG.
B. Control wiring shall be sized such that the voltage drop under in-rush conditions does not adversely affect operation of the controls.

2.5 WIRE LUBRICATING COMPOUND

A. Lubricating compound shall be suitable for the wire insulation and conduit, and shall not harden or become adhesive.
B. Shall not be used on conductors for isolated power systems.

PART 3 - EXECUTION

3.1 GENERAL

A. Install conductors in accordance with the NEC, as specified, and as shown on the drawings.
B. Install all conductors in raceway systems.
C. Splice conductors only in outlet boxes, junction boxes, pullboxes, manholes, or handholes.
D. Conductors of different systems (e.g., 120 V and 277 V) shall not be installed in the same raceway.
E. Install cable supports for all vertical feeders in accordance with the NEC. Provide split wedge type which firmly clamps each individual cable and tightens due to cable weight.
F. In panelboards, cabinets, wireways, switches, enclosures, and equipment assemblies, neatly form, train, and tie the conductors with non-metallic ties.

G. For connections to motors, transformers, and vibrating equipment, stranded conductors shall be used only from the last fixed point of connection to the motors, transformers, or vibrating equipment.
H. Use expanding foam or non-hardening duct-seal to seal conduits entering a building, after installation of conductors.
I. Conductor and Cable Pulling:
    1. Provide installation equipment that will prevent the cutting or abrasion of insulation during pulling. Use lubricants approved for the cable.
    2. Use nonmetallic pull ropes.
    3. Attach pull ropes by means of either woven basket grips or pulling eyes attached directly to the conductors.
    4. All conductors in a single conduit shall be pulled simultaneously.
    5. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
J. No more than three branch circuits shall be installed in any one conduit.
K. When stripping stranded conductors, use a tool that does not damage the conductor or remove conductor strands.

3.2 INSTALLATION IN MANHOLES
A. Train the cables around the manhole walls, but do not bend to a radius less than six times the overall cable diameter.

3.3 SPLICE AND TERMINATION INSTALLATION
A. Splices and terminations shall be mechanically and electrically secure, and tightened to manufacturer's published torque values using a torque screwdriver or wrench.
B. Where the Engineer determines that unsatisfactory splices or terminations have been installed, replace the splices or terminations at no additional cost to the Owner.

3.4 CONDUCTOR IDENTIFICATION
A. When using colored tape to identify phase, neutral, and ground conductors larger than No. 8 AWG, apply tape in half-overlapping turns for a minimum of 75 mm (3 inches) from terminal points, and in junction boxes, pullboxes, and manholes. Apply the last two laps of tape with no tension to prevent possible unwinding. Where cable markings are covered by tape, apply tags to cable, stating size and insulation type.

3.5 FEEDER CONDUCTOR IDENTIFICATION
A. In each interior pullbox and each underground manhole and handhole, install brass tags on all feeder conductors to clearly designate their circuit identification and voltage. The tags shall be the embossed type, 40 mm (1-1/2 inches) in diameter and 40 mils thick. Attach tags with plastic ties.

3.6 EXISTING CONDUCTORS
A. Unless specifically indicated on the plans, existing conductors shall not be reused.

3.7 CONTROL WIRING INSTALLATION
A. Unless otherwise specified in other sections, install control wiring and connect to equipment to perform the required functions as specified or as shown on the drawings.
B. Install a separate power supply circuit for each system, except where otherwise shown on the drawings.

3.8 CONTROL WIRING IDENTIFICATION
A. Install a permanent wire marker on each wire at each termination.
B. Identifying numbers and letters on the wire markers shall correspond to those on the wiring diagrams used for installing the systems.
C. Wire markers shall retain their markings after cleaning.
D. In each manhole and handhole, install embossed brass tags to identify the system served and function.

3.9 DIRECT BURIAL CABLE INSTALLATION

A. Tops of the cables:
   1. Below the finished grade: Minimum 600 mm (24 inches) unless greater depth is shown.
   2. Below road and other pavement surfaces: In conduit as specified, minimum 760 mm (30 inches) unless greater depth is shown.
   3. Do not install cables under railroad tracks.
B. Under road and paved surfaces: Install cables in concrete-encased galvanized steel rigid conduits. Size as shown on plans, but not less than 50 mm (2 inches) trade size with bushings at each end of each conduit run. Provide size/quantity of conduits required to accommodate cables plus one spare.
C. Work with extreme care near existing ducts, conduits, cables, and other utilities to prevent any damage.
D. Excavation and backfill is specified in Section 31 20 00, EARTH MOVING. In addition:
   1. Place 75 mm (3 inches) bedding sand in the trenches before installing the cables.
   2. Place 75 mm (3 inches) shading sand over the installed cables.
   3. Install continuous horizontal 25 mm by 200 mm (1 inch x 8 inches) preservative-impregnated wood planking 75 mm (3 inches) above the cables before backfilling.
E. Provide horizontal slack in the cables for contraction during cold weather.
F. Install the cables in continuous lengths. Splices within cable runs shall not be accepted.
G. Connections and terminations shall be listed submersible-type designed for the cables being installed.
H. Warning tape shall be continuously placed 300 mm (12 inches) above the buried cables.//

3.10 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
   1. Visual Inspection and Tests: Inspect physical condition.
   2. Electrical tests:
      a. After installation but before connection to utilization devices, such as fixtures, motors, or appliances, test conductors phase-to-phase and phase-to-ground resistance with an insulation resistance tester. Existing conductors to be reused shall also be tested.
      b. Applied voltage shall be 500 V DC for 300 V rated cable, and 1000 V DC for 600 V rated cable. Apply test for one minute or until reading is constant for 15 seconds, whichever is longer. Minimum insulation resistance values shall not be less than 25 megohms for 300 V rated cable and 100 megohms for 600 V rated cable.
      c. Perform phase rotation test on all three-phase circuits.

END OF SECTION

SECTION 260526

GROUNDING & BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION
- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. “Grounding electrode system” refers to grounding electrode conductors and all electrodes required or allowed by NEC, as well as made, supplementary, and lightning protection system grounding electrodes.
- C. The terms “connect” and “bond” are used interchangeably in this section and have the same meaning.

1.2 RELATED WORK
- A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
- C. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
- D. Section 26 24 16, PANELBOARDS: Low-voltage panelboards.

1.3 QUALITY ASSURANCE
- A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS
- A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
  1. Shop Drawings:
     - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
     - b. Submit plans showing the location of system grounding electrodes and connections, and the routing of aboveground and underground grounding electrode conductors.
  2. Test Reports:
     - a. Two weeks prior to the final inspection, submit ground resistance field test reports to the Engineer.
  3. Certifications:
     - a. Certification by the Contractor that the grounding equipment has been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS
- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
  B1-07 ..... Standard Specification for Hard-Drawn Copper Wire
  B3-07 ..... Standard Specification for Soft or Annealed Copper Wire
  B8-11 ..... Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

81-83 ..... IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements

D. National Fire Protection Association (NFPA):
   70-11 ..... National Electrical Code (NEC)
   70E-12 ..... National Electrical Safety Code
   99-12 ..... Health Care Facilities
E. Underwriters Laboratories, Inc. (UL):
   44-10 ..... Thermoset-Insulated Wires and Cables
   83-08 ..... Thermoplastic-Insulated Wires and Cables
   467-07 ..... Grounding and Bonding Equipment

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.
D. Insulation: THHN-THWN and XHHW-2. XHHW-2 shall be used for isolated power systems.

2.2 GROUND RODS

A. Steel or copper clad steel, 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
B. Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 CONCRETE ENCASED ELECTRODE

A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

2.4 GROUND CONNECTIONS

A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
B. Above Grade:
   1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated or cadmium-plated/ steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
   2. Connection to Building Steel: Exothermic-welded type connectors.
   3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated or cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
   4. Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated or cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.5 EQUIPMENT RACK AND CABINET GROUND BARS

A. Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 inch) thick x 19 mm (0.75 inch) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.6 GROUND TERMINAL BLOCKS

A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated or cadmium-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

2.7 GROUNDING BUS BAR

A. Pre-drilled rectangular copper bar with stand-off insulators, minimum 6.3 mm (0.25 inch) thick x 100 mm (4 inches) high in cross-section, length as shown on the drawings, with hole size, quantity, and spacing per detail shown on the drawings. Provide insulators and mounting brackets.

PART 3 - EXECUTION

3.1 GENERAL

A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
B. System Grounding:
   1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
   2. Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

3.2 INACCESSIBLE GROUNDING CONNECTIONS

A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.3 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

A. Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.
B. Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per NEC except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.
C. Pad-Mounted Transformers:
   1. Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad.
   2. Ground the secondary neutral.
D. Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods as applicable.

3.4 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
   1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.
   2. Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

C. Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:
   1. Connect the equipment grounding conductors to the ground bus.
   2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.
D. Transformers:
   1. Exterior: Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.
   2. Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system or to the ground bar at the service equipment.

3.5 RACEWAY

A. Conduit Systems:
   1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
   2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
   3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
   4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.
B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
C. Boxes, Cabinets, Enclosures, and Panelboards:
   1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
   2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
D. Wireway Systems:
   1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
   2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).
   3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
   4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.
H. Raised Floors: Provide bonding for all raised floor components as shown on the drawings.
I. Panelboard Bonding in Patient Care Areas: The equipment grounding terminal buses of the normal and essential branch circuit panel boards serving the same individual patient vicinity shall

be bonded together with an insulated continuous copper conductor not less than No. 10 AWG, installed in rigid metal conduit.

3.6 DELETED

3.7 CORROSION INHIBITORS

A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.8 CONDUCTIVE PIPING

A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.
B. In operating rooms and at intensive care and tonary care type beds, bond the medical gas piping and medical vacuum piping at the outlets directly to the patient ground bus.

3.9 DELETED

3.10 MAIN ELECTRICAL ROOM GROUNDING

A. Provide ground bus bar and mounting hardware at each main electrical room where incoming feeders are terminated, as shown on the drawings. Connect to pigtail extensions of the building grounding ring, as shown on the drawings.

3.11 DELETED

3.12 GROUND RESISTANCE

A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Owner. Final tests shall ensure that this requirement is met.
B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.13 GROUND ROD INSTALLATION

A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.
C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.14 ACCEPTANCE CHECKS AND TESTS

A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
C. Below-grade connections shall be visually inspected by the Engineer prior to backfilling. The Contractor shall notify the Engineer 24 hours before the connections are ready for inspection.

END OF SECTION

SECTION 260533

RACEWAY & BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements and items that are common to more than one section of Division 26.
B. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.

1.3 QUALITY ASSURANCE

Refer to Paragraph, QUALIFICATIONS, in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
    1. Shop Drawings:
        a. Size and location of main feeders.
        b. Size and location of panels and pull-boxes.
        c. Layout of required conduit penetrations through structural elements.
        d. Submit the following data for approval:
            1) Raceway types and sizes.
            2) Conduit bodies, connectors and fittings.
            3) Junction and pull boxes, types and sizes.
    2. Certifications: Two weeks prior to final inspection, submit the following:
        a. Certification by the manufacturer that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment conform to the requirements of the drawings and specifications.
        b. Certification by the Contractor that raceways, conduits, conduit bodies, connectors, fittings, junction and pull boxes, and all related equipment have been properly installed.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. American National Standards Institute (ANSI):
    C80.1-05 ..... Electrical Rigid Steel Conduit
    C80.3-05 ..... Steel Electrical Metal Tubing
    C80.6-05 ..... Electrical Intermediate Metal Conduit
C. National Fire Protection Association (NFPA):
    70-11 ..... National Electrical Code (NEC)
D. Underwriters Laboratories, Inc. (UL):
    1-05 ..... Flexible Metal Conduit

5-11 ..... Surface Metal Raceway and Fittings
6-07 ..... Electrical Rigid Metal Conduit - Steel
50-95 ..... Enclosures for Electrical Equipment
360-13 ..... Liquid-Tight Flexible Steel Conduit
467-13 ..... Grounding and Bonding Equipment
514A-13..... Metallic Outlet Boxes
514B-12..... Conduit, Tubing, and Cable Fittings
514C-07 ..... Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers
651-11 ..... Schedule 40 and 80 Rigid PVC Conduit and Fittings
651A-11..... Type EB and A Rigid PVC Conduit and HDPE Conduit
797-07 ..... Electrical Metallic Tubing
1242-06 ..... Electrical Intermediate Metal Conduit - Steel

E. National Electrical Manufacturers Association (NEMA):
TC-2-13 ..... Electrical Polyvinyl Chloride (PVC) Tubing and Conduit
TC-3-13 ..... PVC Fittings for Use with Rigid PVC Conduit and Tubing
FB1-12..... Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable
FB2.10-13 ..... Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)
FB2.20-12 ..... Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable

F. American Iron and Steel Institute (AISI):
S100-2007..... North American Specification for the Design of Cold-Formed Steel Structural Members

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.
B. Conduit:
1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
3. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
4. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
5. Flexible Metal Conduit: Shall conform to UL 1.
6. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
7. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
8. Surface Metal Raceway: Shall conform to UL 5.

C. Conduit Fittings:
1. Rigid Steel and Intermediate Metallic Conduit Fittings:
a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use

set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.

f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.

2. Electrical Metallic Tubing Fittings:
   a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
   d. Indent-type connectors or couplings are prohibited.
   e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.
4. Flexible Metal Conduit Fittings:
   a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
   b. Clamp-type, with insulated throat.
5. Liquid-tight Flexible Metal Conduit Fittings:
   a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
   b. Only steel or malleable iron materials are acceptable.
   c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
7. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
8. Expansion and Deflection Couplings:
   a. Conform to UL 467 and UL 514B.
   b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
   c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
   d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.

D. Conduit Supports:
   1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
   2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
   3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
   4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
E. Outlet, Junction, and Pull Boxes:
   1. UL-50 and UL-514A.
   2. Rustproof cast metal where required by the NEC or shown on drawings.
   3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

PART 3 - EXECUTION

3.1 PENETRATIONS

A. Cutting or Holes:
   1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the Engineer prior to drilling through structural elements.
   2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed, except when permitted by the Engineer where working space is limited.

B. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING.

C. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight, as specified in Section 07 92 00, JOINT SEALANTS.

3.2 INSTALLATION, GENERAL

A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.

B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.

C. Install conduit as follows:
   1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
   2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
   3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
   4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
   5. Cut conduits square, ream, remove burrs, and draw up tight.
   6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
   7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
   8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
   9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
   10. Conduit installations under fume and vent hoods are prohibited.
   11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
   12. Flashing of penetrations of the roof membrane is specified in Section 07 60 00, FLASHING AND SHEET METAL.
   13. Conduit bodies shall only be used for changes in direction, and shall not contain splices.

D. Conduit Bends:
   1. Make bends with standard conduit bending machines.
   2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
   3. Bending of conduits with a pipe tee or vise is prohibited.

E. Layout and Homeruns:
   1. Install conduit with wiring, including homeruns, as shown on drawings.
   2. Deviations: Make only where necessary to avoid interferences and only after drawings showing the proposed deviations have been submitted and approved by the Engineer.

3.3 CONCEALED WORK INSTALLATION

A. In Concrete:

1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
2. Align and run conduit in direct lines.
3. Install conduit through concrete beams only:
   a. Where shown on the structural drawings.
   b. As approved by the Engineer prior to construction, and after submittal of drawing showing location, size, and position of each penetration.
4. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
   a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
   b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
   c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
5. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

B. Above Furred or Suspended Ceilings and in Walls:
1. Conduit for Conductors Above 600 V: Rigid steel. Mixing different types of conduits in the same system is prohibited.
2. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.
6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

3.4 EXPOSED WORK INSTALLATION

A. Unless otherwise indicated on drawings, exposed conduit is only permitted in mechanical and electrical rooms.
B. Conduit for Conductors Above 600 V: Rigid steel or rigid aluminum. Mixing different types of conduits in the system is prohibited.
C. Conduit for Conductors 600 V and Below: Rigid steel, IMC, or EMT. Mixing different types of conduits in the system is prohibited.
D. Align and run conduit parallel or perpendicular to the building lines.
E. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
F. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
G. Surface Metal Raceways: Use only where shown on drawings.
H. Painting:
1. Paint exposed conduit as specified in Section 09 91 00, PAINTING.
2. Paint all conduits containing cables rated over 600 V safety orange. Refer to Section 09 91 00, PAINTING for preparation, paint type, and exact color. In addition, paint legends, using 50 mm (2 inch) high black numerals and letters, showing the cable voltage rating. Provide legends where conduits pass through walls and floors and at maximum 6 M (20 feet) intervals in between.

3.5 DIRECT BURIAL INSTALLATION

Refer to Section 26 05 41, UNDERGROUND ELECTRICAL CONSTRUCTION.

3.6 HAZARDOUS LOCATIONS

A. Use rigid steel conduit only.
B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.

3.7 WET OR DAMP LOCATIONS

A. Use rigid steel or IMC conduits unless as shown on drawings.
B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or re-tape any damaged areas of coating.
D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

3.8 MOTORS AND VIBRATING EQUIPMENT

A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

3.9 EXPANSION JOINTS

A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.
C. Install expansion and deflection couplings where shown.

3.10 CONDUIT SUPPORTS

A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
B. Use pipe straps or individual conduit hangers for supporting individual conduits.
C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs.). Attach each conduit with U-bolts or other approved fasteners.
D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
E. Fasteners and Supports in Solid Masonry and Concrete:
    1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
    2. Existing Construction:
        a. Steel expansion anchors not less than 6 mm (0.25-inch) bolt size and not less than 28 mm (1.125 inch) in embedment.
        b. Power set fasteners not less than 6 mm (0.25-inch) diameter with depth of penetration not less than 75 mm (3 inch).
        c. Use vibration and shock-resistant anchors and fasteners for attaching to concrete ceilings.
F. Hollow Masonry: Toggle bolts.
G. Bolts supported only by plaster or gypsum wallboard are not acceptable.

H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
K. Spring steel type supports or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

3.11 BOX INSTALLATION

A. Boxes for Concealed Conduits:
   1. Flush-mounted.
   2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of 4-90 degree bends are necessary.
C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.
G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
H. Stencil or install phenolic nameplates on covers of the boxes identified on riser diagrams; for example "SIG-FA JB No. 1."
I. On all branch circuit junction box covers, identify the circuits with black marker.

END OF SECTION

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of panelboards.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
    1. Shop Drawings:
        a. Submit sufficient information to demonstrate compliance with drawings and specifications.
        b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
    2. Manuals:
        a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering circuit breakers and replacement parts.
            1) Include schematic diagrams, with all terminals identified, matching terminal identification in the panelboards.
            2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
        b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
    3. Certifications: Two weeks prior to final inspection, submit the following.
        a. Certification by the manufacturer that the panelboards conform to the requirements of the drawings and specifications.
        b. Certification by the Contractor that the panelboards have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. International Code Council (ICC):
IBC-12 .....International Building Code
C. National Electrical Manufacturers Association (NEMA):

PB 1-11 ..... Panelboards
250-08 ..... Enclosures for Electrical Equipment (1,000V Maximum)

D. National Fire Protection Association (NFPA):
70-11 ..... National Electrical Code (NEC)
70E-12 ..... Standard for Electrical Safety in the Workplace

E. Underwriters Laboratories, Inc. (UL):
50-95 ..... Enclosures for Electrical Equipment
67-09 ..... Panelboards
489-09 ..... Molded Case Circuit Breakers and Circuit Breaker Enclosures

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
E. Bus bar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.
F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
G. Neutral bus shall be 100% rated, mounted on insulated supports.
H. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
I. Bus bars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 10,000 A symmetrical for 120/208 V and 120/240 V panelboards, and 14,000 A symmetrical for 277/480 V panelboards.
J. In two-section panelboards, the main bus in each section shall be full size. The first section shall be furnished with subfeed lugs on the line side of main lugs only, or through-feed lugs for main breaker type panelboards, and have field-installed cable connections to the second section as shown on the drawings. Panelboard sections with tapped bus or crossover bus are not acceptable.
K. Series-rated panelboards are not permitted.

2.2 ENCLOSURES AND TRIMS

A. Enclosures:
1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
2. Enclosures shall not have ventilating openings.
3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide manufacturer’s standard option for pre-punched knockouts on top and bottom endwalls.
5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:
1. Hinged “door-in-door” type.
2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.

5. Trims shall be flush or surface type as shown on the drawings.

2.3 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.
B. Circuit breakers shall be bolt-on type.
C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:
   1. 120/208 V Panelboard: 10,000 A symmetrical.
   2. 120/240 V Panelboard: 10,000 A symmetrical.
   3. 277/480 V Panelboard: 14,000 A symmetrical.
D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker trip setting shall be set in the field.
E. Circuit breaker features shall be as follows:
   1. A rugged, integral housing of molded insulating material.
   2. Silver alloy contacts.
   3. Arc quenchers and phase barriers for each pole.
   4. Quick-make, quick-break, operating mechanisms.
   5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
   6. Electrically and mechanically trip free.
   7. An operating handle which indicates closed, tripped, and open positions.
   8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
   9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.

2.4 SURGE PROTECTIVE DEVICES

A. Where shown on the drawings, furnish panelboards with integral surge protective devices.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer’s instructions, the NEC, as shown on the drawings, and as specified.
B. Locate panelboards so that the present and future conduits can be conveniently connected.
C. Install a printed schedule of circuits in each panelboard after approval by the Engineer. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards
D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
E. Provide blank cover for each unused circuit breaker mounting space.
F. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
   1. Visual Inspection and Tests:
      a. Compare equipment nameplate data with specifications and approved shop drawings.
      b. Inspect physical, electrical, and mechanical condition.
      c. Verify appropriate anchorage and required area clearances.
      d. Verify that circuit breaker sizes and types correspond to approved shop drawings.

e. To verify tightness of accessible bolted electrical connections, use the calibrated torque-wrench method or perform thermographic survey after energization.
f. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks, settings, and tests, the Contractor shall demonstrate that the panelboards are in good operating condition and properly performing the intended function.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: General electrical requirements that are common to more than one section of Division 26.
B. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit and boxes.
C. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Cables and wiring.
D. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
E. Section 26 51 00, INTERIOR LIGHTING: Fluorescent ballasts and LED drivers for use with manual dimming controls.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
    1. Shop Drawings:
        a. Submit sufficient information to demonstrate compliance with drawings and specifications.
        b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
    2. Manuals:
        a. Submit, simultaneously with the shop drawings, companion copies of complete maintenance and operating manuals, including technical data sheets and information for ordering replacement parts.
        b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
    3. Certifications: Two weeks prior to final inspection, submit the following.
        a. Certification by the manufacturer that the wiring devicescor conform to the requirements of the drawings and specifications.
        b. Certification by the Contractor that the wiring devices have been properly installed and adjusted.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
B. National Fire Protection Association (NFPA):
    70-11 .....National Electrical Code (NEC)
    99-12 .....Health Care Facilities

C. National Electrical Manufacturers Association (NEMA):
   WD 1-10 ..... General Color Requirements for Wiring Devices
   WD 6-08 ..... Wiring Devices – Dimensional Specifications
D. Underwriter's Laboratories, Inc. (UL):
   5-11 ..... Surface Metal Raceways and Fittings
   20-10 ..... General-Use Snap Switches
   231-07 ..... Power Outlets
   467-07 ..... Grounding and Bonding Equipment
   498-07 ..... Attachment Plugs and Receptacles
   943-11 ..... Ground-Fault Circuit-Interrupters
   1449-07 ..... Surge Protective Devices
   1472-96 ..... Solid State Dimming Controls

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. General: All receptacles shall comply with NEMA, NFPA, UL, and as shown on the drawings.
   1. Mounting straps shall be plated steel, with break-off plaster ears and shall include a self-grounding feature. Terminal screws shall be brass, brass plated or a copper alloy metal.
   2. Receptacles shall have provisions for back wiring with separate metal clamp type terminals (four minimum) and side wiring from four captively held binding screws.
B. Duplex Receptacles: single phase, 20 ampere, 120 volts, 2-pole, 3-wire, NEMA 5-20R, with break-off feature for two-circuit operation.
   1. Bodies shall be brown in color.
   2. Switched duplex receptacles shall be wired so that only the top receptacle is switched. The lower receptacle shall be unswitched.
   3. Duplex Receptacles on Emergency Circuit:
      a. In rooms without emergency powered general lighting, the emergency receptacles shall be of the self-illuminated type.
   4. Ground Fault Interrupter Duplex Receptacles: Shall be an integral unit, suitable for mounting in a standard outlet box, with end-of-life indication and provisions to isolate the face due to improper wiring.
      a. Ground fault interrupter shall be consist of a differential current transformer, solid state sensing circuitry and a circuit interrupter switch. Device shall have nominal sensitivity to ground leakage current of 4-6 milliamperes and shall function to interrupt the current supply for any value of ground leakage current above five milliamperes (+ or – 1 milliampere) on the load side of the device. Device shall have a minimum nominal tripping time of 0.025 second.
C. Receptacles; 20, 30, and 50 ampere, 250 Volts: Shall be complete with appropriate cord grip plug.
D. Weatherproof Receptacles: Shall consist of a duplex receptacle, mounted in box with a gasketed, weatherproof, cast metal cover plate and cap over each receptacle opening. The cap shall be permanently attached to the cover plate by a spring-hinged flap. The weatherproof integrity shall not be affected when heavy duty specification or hospital grade attachment plug caps are inserted. Cover plates on outlet boxes mounted flush in the wall shall be gasketed to the wall in a watertight manner.

2.2 TOGGLE SWITCHES

A. Toggle switches shall be totally enclosed tumbler type with nylon bodies. Handles shall be brown in color unless otherwise specified or shown on the drawings.
   1. Switches installed in hazardous areas shall be explosion-proof type in accordance with the NEC and as shown on the drawings.
   2. Shall be single unit toggle, butt contact, quiet AC type, heavy-duty general-purpose use with an integral self-grounding mounting strap with break-off plasters ears and provisions for back wiring with separate metal wiring clamps and side wiring with captively held binding screws.

3. Switches shall be rated 20 amperes at 120-277 Volts AC.

2.3 MANUAL DIMMING CONTROL

A. Electronic full-wave manual slide dimmer with on/off switch and audible frequency and EMI/RFI suppression filters.
B. Manual dimming controls shall be fully compatible with LED dimming drivers, be approved by the driver manufacturer, shall operate over full specified dimming range, and shall not degrade the performance or rated life of the electronic dimming ballast and lamp.
C. Provide single-pole or three-way, as shown on the drawings.
D. Manual dimming control and faceplates shall be brown in color unless otherwise specified.

2.4 WALL PLATES

A. Wall plates for switches and receptacles shall be type 302 stainless steel in the kitchen and washing areas, and smooth nylon elsewhere. Oversize plates are not acceptable.
B. Color shall be brown unless otherwise specified.
C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.
D. In areas requiring tamperproof wiring devices, wall plates shall be type 302 stainless steel, and shall have tamperproof screws and beveled edges.

2.5 SURFACE MULTIPLE-OUTLET ASSEMBLIES

A. Shall have the following features:
   1. Enclosures:
      a. Thickness of steel shall be not less than 1 mm (0.040 inch) for base and cover. Nominal dimensions shall be 40 mm x 70 mm (1-1/2 inches by 2-3/4 inches) with inside cross sectional area not less than 2250 square mm (3-1/2 square inches). The enclosures shall be thoroughly cleaned, phosphatized, and painted at the factory with primer and the manufacturer's standard baked enamel finish.
   2. Receptacles shall be duplex. See paragraph 'RECEPTACLES' in this Section. Device cover plates shall be the manufacturer's standard corrosion resistant finish and shall not exceed the dimensions of the enclosure.
   3. Unless otherwise shown on drawings, receptacle spacing shall be 600 mm (24 inches) on centers.
   4. Conductors shall be as specified in Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLE.
   5. Installation fittings shall be the manufacturer’s standard bends, offsets, device brackets, inside couplings, wire clips, elbows, and other components as required for a complete system.
   6. Bond the assemblies to the branch circuit conduit system.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC and as shown as on the drawings.
B. Install wiring devices after wall construction and painting is complete.
C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
E. Provide barriers in multi-gang outlet boxes to comply with the NEC.
F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material. Pay special attention to installations in cabinet work, and in connection with laboratory equipment.
G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of

conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.

H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
I. Install wall dimmers 1.2 M (48 inches) above floor.
J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
K. Install vertically mounted receptacles with the ground pin up. Install horizontally mounted receptacles with the ground pin to the right.
L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.
M. Label device plates with a permanent adhesive label listing panel and circuit feeding the wiring device.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform manufacturer’s required field checks in accordance with the manufacturer's recommendations. In addition, include the following:
    1. Visual Inspection and Tests:
        a. Inspect physical and electrical condition.
        b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
        c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
        d. Test GFCI receptacles.
    2. Healthcare Occupancy Tests:
        a. Test hospital grade receptacles for retention force per NFPA 99.

END OF SECTION

SECTION 262921

ENCLOSED SWITCHES & CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 DESCRIPTION

A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately-enclosed circuit breakers for use in electrical systems rated 600 V and below.

1.2 RELATED WORK

A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
D. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduits.
E. Section 26 24 16, PANELBOARDS: Molded-case circuit breakers.

1.3 QUALITY ASSURANCE

A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS

A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
    1. Shop Drawings:
        a. Submit sufficient information to demonstrate compliance with drawings and specifications.
        b. Submit the following data for approval:
            1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
    2. Manuals:
        a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
            1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
            2) Include information for testing, repair, troubleshooting, assembly, and disassembly.
        b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
    3. Certifications: Two weeks prior to final inspection, submit the following.
        a. Certification by the manufacturer that the enclosed switches and circuit breakers conform to the requirements of the drawings and specifications.
        b. Certification by the Contractor that the enclosed switches and circuit breakers have been properly installed, adjusted, and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
B. International Code Council (ICC):
IBC-12 ..... International Building Code
C. National Electrical Manufacturers Association (NEMA):
FU l-07..... Low Voltage Cartridge Fuses
KS l-06..... Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)
D. National Fire Protection Association (NFPA):
70-11 ..... National Electrical Code (NEC)
E. Underwriters Laboratories, Inc. (UL):
98-07 ..... Enclosed and Dead-Front Switches
248-00 ..... Low Voltage Fuses
489-09 ..... Molded Case Circuit Breakers and Circuit Breaker Enclosures

SPEC WRITER NOTE: Delete between // ---- // if not applicable to project. Also delete any other item or paragraph not applicable to the section and renumber the paragraphs.

PART 2 - PRODUCTS

2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
C. Shall be horsepower (HP) rated.
D. Shall have the following features:
1. Switch mechanism shall be the quick-make, quick-break type.
2. Copper blades, visible in the open position.
3. An arc chute for each pole.
4. External operating handle shall indicate open and closed positions, and have lock-open padlocking provisions.
5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
6. Fuse holders for the sizes and types of fuses specified.
7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
a. Shall be the NEMA types shown on the drawings.
b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
c. Shall be finished with manufacturer’s standard gray baked enamel paint over pretreated steel.

2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

A. Shall be the same as fused switches, but without provisions for fuses.

2.3 FUSED SWITCHES RATED OVER 600 AMPERES TO 1200 AMPERES

A. Shall be the same as fused switches, and shall be NEMA classified Heavy Duty (HD).

2.4 MOTOR RATED TOGGLE SWITCHES

A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.

B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

2.5 CARTRIDGE FUSES

A. Shall be in accordance with NEMA FU 1.

2.6 SEPARATELY-ENCLOSED CIRCUIT BREAKERS

A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, PANELBOARDS.
B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

3.2 ACCEPTANCE CHECKS AND TESTS

A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
    1. Visual Inspection and Tests:
        a. Compare equipment nameplate data with specifications and approved shop drawings.
        b. Inspect physical, electrical, and mechanical condition.
        c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
        d. Vacuum-clean enclosure interior. Clean enclosure exterior.

3.3 SPARE PARTS

A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Engineer.

END OF SECTION

SECTION 265100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 DESCRIPTION:
A. This section specifies the furnishing, installation, and connection of the interior lighting systems. The terms “lighting fixture,” “fixture,” and “luminaire” are used interchangeably.

1.2 RELATED WORK
A. Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS: Requirements that apply to all sections of Division 26.
B. Section 26 05 19, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Low-voltage conductors.
C. Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.
D. Section 26 27 26, WIRING DEVICES: Wiring devices used for control of the lighting systems.

1.3 QUALITY ASSURANCE
A. Refer to Paragraph, QUALIFICATIONS (PRODUCTS AND SERVICES), in Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.

1.4 SUBMITTALS
A. Submit six copies of the following in accordance with Section 26 05 11, REQUIREMENTS FOR ELECTRICAL INSTALLATIONS.
1. Shop Drawings:
a. Submit the following information for each type of lighting fixture designated on the LIGHTING FIXTURE SCHEDULE, arranged in order of lighting fixture designation.
b. Material and construction details, include information on housing and optics system.
c. Physical dimensions and description.
d. Wiring schematic and connection diagram.
e. Installation details.
f. Energy efficiency data.
g. Photometric data based on laboratory tests complying with IES Lighting Measurements testing and calculation guides.
h. Lamp data including lumen output (initial and mean), color rendition index (CRI), rated life (hours), and color temperature (degrees Kelvin).
i. Ballast data including ballast type, starting method, ambient temperature, ballast factor, sound rating, system watts, and total harmonic distortion (THD).
j. For LED lighting fixtures, submit US DOE LED Lighting Facts label, and IES L70 rated life.

2. Manuals:
a. Submit, simultaneously with the shop drawings, complete maintenance and operating manuals, including technical data sheets, wiring diagrams, and information for ordering replacement parts.
b. If changes have been made to the maintenance and operating manuals originally submitted, submit updated maintenance and operating manuals two weeks prior to the final inspection.
3. Certifications: Two weeks prior to final inspection, submit the following.

a. Certification by the Contractor that the interior lighting systems have been properly installed and tested.

1.5 APPLICABLE PUBLICATIONS

A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.

B. American National Standards Institute (ANSI):
- C78.1-91 ..... Fluorescent Lamps - Rapid-Start Types - Dimensional and Electrical Characteristics
- C78.376-01 ..... Chromaticity of Fluorescent Lamps

C. American Society for Testing and Materials (ASTM):
- C635-07 ..... Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings

D. Environmental Protection Agency (EPA):
- 40 CFR 261 ..... Identification and Listing of Hazardous Waste

E. Federal Communications Commission (FCC):
- CFR Title 47, Part 15 ..... Radio Frequency Devices
- CFR Title 47, Part 18 ..... Industrial, Scientific, and Medical Equipment

F. Illuminating Engineering Society (IES):
- LM-79-08 ..... Electrical and Photometric Measurements of Solid-State Lighting Products
- LM-80-08 ..... Measuring Lumen Maintenance of LED Light Sources
- LM-82-12 ..... Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature

G. Institute of Electrical and Electronic Engineers (IEEE):
- C62.41-91 ..... Surge Voltages in Low Voltage AC Power Circuits

H. International Code Council (ICC):
- IBC-12 ..... International Building Code

I. National Fire Protection Association (NFPA):
- 70-11 ..... National Electrical Code (NEC)
- 101-12 ..... Life Safety Code

J. National Electrical Manufacturer's Association (NEMA):
- C82.1-04 ..... Lamp Ballasts – Line Frequency Fluorescent Lamp Ballasts
- C82.2-02 ..... Method of Measurement of Fluorescent Lamp Ballasts
- C82.4-02 ..... Lamp Ballasts - Ballasts for High-Intensity Discharge and Low-Pressure Sodium (LPS) Lamps (Multiple-Supply Type)
- C82.11-11 ..... Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts
- LL-9-09 ..... Dimming of T8 Fluorescent Lighting Systems
- SSL-1-10 ..... Electronic Drivers for LED Devices, Arrays, or Systems

K. Underwriters Laboratories, Inc. (UL):
- 496-08 ..... Lampholders
- 542-0599 ..... Fluorescent Lamp Starters
- 844-12 ..... Luminaires for Use in Hazardous (Classified) Locations
- 924-12 ..... Emergency Lighting and Power Equipment
- 935-01 ..... Fluorescent-Lamp Ballasts
- 1029-94 ..... High-Intensity-Discharge Lamp Ballasts
- 1029A-06 ..... Ignitors and Related Auxiliaries for HID Lamp Ballasts
- 1598-08 ..... Luminaires
- 1574-04 ..... Track Lighting Systems
- 2108-04 ..... Low-Voltage Lighting Systems
- 8750-09 ..... Light Emitting Diode (LED) Light Sources for Use in Lighting Products

PART 2 - PRODUCTS

2.1 LIGHTING FIXTURES

A. Shall be in accordance with NFPA, UL, as shown on drawings, and as specified.
B. Sheet Metal:
   1. Shall be formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
   2. Wireways and fittings shall be free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
   3. When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
   4. Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
C. Ballasts and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts shall not be mounted to removable reflectors or wireway covers unless so specified.
D. Deleted.
E. Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.
F. Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
G. Metal Finishes:
   1. The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
   2. Interior light reflecting finishes shall be white with not less than 85 percent reflectances, except where otherwise shown on the drawing.
   3. Exterior finishes shall be as shown on the drawings.
H. Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
I. Light Transmitting Components for Lensed Troffer Fixtures:
   1. Shall be 100 percent virgin acrylic.
   2. Flat lens panels shall have not less than 3 mm (1/8 inch) of average thickness.
   3. Unless otherwise specified, lenses, reflectors, diffusers, and louvers shall be retained firmly in a metal frame by clips or clamping ring in such a manner as to allow expansion and contraction without distortion or cracking.
J. Lighting fixtures in hazardous areas shall be suitable for installation in Class and Division areas as defined in NFPA 70.

2.2 EMERGENCY LIGHTING UNIT

A. Complete, self-contained unit with batteries, battery charger, one or more local or remote lamp heads with lamps, under-voltage relay, and test switch.
   1. Enclosure: Shall be impact-resistant thermoplastic. Enclosure shall be suitable for the environmental conditions in which installed.
   2. Lamp Heads: Horizontally and vertically adjustable, mounted on the face of the unit, except where otherwise indicated.
   3. Lamps: Shall be LED.
   4. Battery: Shall be maintenance-free nickel-cadmium. Minimum normal life shall be minimum of 10 years.
   5. Battery Charger: Dry-type full-wave rectifier with charging rates to maintain the battery in fully-charged condition during normal operation, and to automatically recharge the battery within 12 hours following a 1-1/2 hour continuous discharge.

6. Integral Self-Test: Automatically initiates test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing LED.

2.3 LED EXIT LIGHT FIXTURES

A. Exit light fixtures shall meet applicable requirements of NFPA and UL.
B. Housing and door shall be die-cast aluminum.
C. For general purpose exit light fixtures, door frame shall be hinged, with latch. For vandal-resistant exit light fixtures, door frame shall be secured with tamper-resistant screws.
D. Finish shall be satin or fine-grain brushed aluminum.
E. There shall be no radioactive material used in the fixtures.
F. Fixtures:
   1. Inscription panels shall be cast or stamped aluminum a minimum of 2.25 mm (0.090 inch) thick, stenciled with 150 mm (6 inch) high letters, baked with red color stable plastic or fiberglass. Lamps shall be luminous Light Emitting Diodes (LED) mounted in center of letters on red color stable plastic or fiberglass.
   2. Double-Faced Fixtures: Provide double-faced fixtures where required or as shown on drawings.
   3. Directional Arrows: Provide directional arrows as part of the inscription panel where required or as shown on drawings. Directional arrows shall be the "chevron-type" of similar size and width as the letters and meet the requirements of NFPA 101.
G. Voltage: Multi-voltage (120 – 277V).

2.10 LED LIGHT FIXTURES

A. General:
   1. LED light fixtures shall be in accordance with IES, NFPA, UL, as shown on the drawings, and as specified.
   2. LED light fixtures shall be Reduction of Hazardous Substances (RoHS)-compliant.
   3. LED drivers shall include the following features unless otherwise indicated:
      a. Minimum efficiency: 85% at full load.
      b. Minimum Operating Ambient Temperature: -20˚ C. (-4˚ F.)
      c. Input Voltage: 120 - 277V (±10%) at 60 Hz.
      d. Integral short circuit, open circuit, and overload protection.
      e. Power Factor: ≥ 0.95.
      f. Total Harmonic Distortion: ≤ 20%.
      g. Comply with FCC 47 CFR Part 15.
   4. LED modules shall include the following features unless otherwise indicated:
      a. Comply with IES LM-79 and LM-80 requirements.
      b. Minimum CRI 80 and color temperature 3000˚ K unless otherwise specified in LIGHTING FIXTURE SCHEDULE.
      c. Minimum Rated Life: 50,000 hours per IES L70.
      d. Light output lumens as indicated in the LIGHTING FIXTURE SCHEDULE.
B. LED Downlights:
   1. Housing, LED driver, and LED module shall be products of the same manufacturer.
C. LED Troffers:
   1. LED drivers, modules, and reflector shall be accessible, serviceable, and replaceable from below the ceiling.
   2. Housing, LED driver, and LED module shall be products of the same manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation shall be in accordance with the NEC, manufacturer's instructions, and as shown on the drawings or specified.
B. Align, mount, and level the lighting fixtures uniformly.

C. Wall-mounted fixtures shall be attached to the studs in the walls, or to a 20 gauge metal backing plate that is attached to the studs in the walls. Lighting fixtures shall not be attached directly to gypsum board.
D. Lighting Fixture Supports:
    1. Shall provide support for all of the fixtures. Supports may be anchored to channels of the ceiling construction, to the structural slab or to structural members within a partition, or above a suspended ceiling.
    2. Shall maintain the fixture positions after cleaning.
    3. Shall support the lighting fixtures without causing the ceiling or partition to deflect.
    4. Surface mounted lighting fixtures:
        a. Fixtures shall be bolted against the ceiling independent of the outlet box at four points spaced near the corners of each unit. The bolts (or stud-clips) shall be minimum 6 mm (1/4 inch) bolt, secured to main ceiling runners and/or secured to cross runners. Non-turning studs may be attached to the main ceiling runners and cross runners with special non-friction clip devices designed for the purpose, provided they bolt through the runner, or are also secured to the building structure by 12 gauge safety hangers. Studs or bolts securing fixtures weighing in excess of 25 kg (56 pounds) shall be supported directly from the building structure.
        b. Where ceiling cross runners are installed for support of lighting fixtures, they must have a carrying capacity equal to that of the main ceiling runners and be rigidly secured to the main runners.
        c. Fixtures less than 6.8 kg (15 pounds) in weight and occupying less than 3715 sq. cm (two square feet) of ceiling area may, when designed for the purpose, be supported directly from the outlet box when all the following conditions are met.
            1) Screws attaching the fixture to the outlet box pass through round holes (not key-hole slots) in the fixture body.
            2) The outlet box is attached to a main ceiling runner (or cross runner) with approved hardware.
            3) The outlet box is supported vertically from the building structure.
        d. Fixtures mounted in open construction shall be secured directly to the building structure with approved bolting and clamping devices.
    8. Single or double pendant-mounted lighting fixtures:
        a. Each stem shall be supported by an approved outlet box mounted swivel joint and canopy which holds the stem captive and provides spring load (or approved equivalent) dampening of fixture oscillations. Outlet box shall be supported vertically from the building structure.
    9. Outlet boxes for support of lighting fixtures (where permitted) shall be secured directly to the building structure with approved devices or supported vertically in a hung ceiling from the building structure with a nine gauge wire hanger, and be secured by an approved device to a main ceiling runner or cross runner to prevent any horizontal movement relative to the ceiling.
E. Furnish and install the new lamps as specified for all lighting fixtures installed under this project, and for all existing lighting fixtures reused under this project.
F. The electrical and ceiling trades shall coordinate to ascertain that approved lighting fixtures are furnished in the proper sizes and installed with the proper devices (hangers, clips, trim frames, flanges, etc.), to match the ceiling system being installed.
G. Bond lighting fixtures to the grounding system as specified in Section 26 05 26, GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS.
H. At completion of project, replace all defective components of the lighting fixtures at no cost to the Owner.

3.2 ACCEPTANCE CHECKS AND TESTS
A. Perform the following:
    1. Visual Inspection:
        a. Verify proper operation by operating the lighting controls.

b. Visually inspect for damage to fixtures, lenses, reflectors, diffusers, and louvers. Clean fixtures, lenses, reflectors, diffusers, and louvers that have accumulated dust, dirt, or fingerprints during construction.

2. Electrical tests:
   a. Exercise dimming components of the lighting fixtures over full range of dimming capability by operating the control devices(s) in the presence of the Engineer. Observe for visually detectable flicker over full dimming range, and replace defective components at no cost to the Owner.
   b. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in period to be 40 hours minimum, unless specifically recommended otherwise by the lamp manufacturer. Burn-in dimmed fluorescent and compact fluorescent lamps for at least 100 hours at full voltage, unless specifically recommended otherwise by the lamp manufacturer. Replace any lamps and ballasts which fail during burn-in.

3.3 FOLLOW-UP VERIFICATION

A. Upon completion of acceptance checks and tests, the Contractor shall show by demonstration in service that the lighting systems are in good operating condition and properly performing the intended function.

END OF SECTION

SECTION 311100

CLEARING AND GRUBBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

B. Earthwork: Section 312000

1.03 PROJECT CONDITIONS

A. Existing Conditions: Do not disturb existing woodlands to remain, open meadow areas, or areas immediately outside of the construction areas, unless noted under requirements of the contract.

B. Liquidated damages in the amount of Five Hundred Dollars ($500) per tree will be deducted from the contract for all existing trees scheduled to remain greater than 6 inch DBH (Diameter Breast Height)s, that are erroneously scarred, scraped, or substantially damaged due to construction activities. The final determination on this damage and quantity shall remain the decision of the Director's Representative.

1.04 SCOPE OF WORK

A. This Work shall consist of clearing, grubbing, removing and disposing of all trees, brush, stumps, fences, debris, and miscellaneous structures not covered under other contract items within the construction area and such other areas as specified or directed.

B. The Contractor shall clear areas within the limits of construction and as directed during construction activities by the Director's Representative.

C. Materials generated by the Work, including construction and demolition debris, shall not be disposed of by burning on or off site. Off-site burning in a permitted solid waste incinerator or in another lawful manner as refuse derived fuel will be permitted.

D. Owner will retain (4) Log Sections and suitable boulders for project use. Logs and Boulders to remain shall be marked by Director's Representative.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.01 PREPARATION

A. Limit of Work Areas:
The Director's Representative shall delineate and illustrate the general limits of areas to be cleared and grubbed, to be cleared but not grubbed, or areas, objects or features that are designated to remain undisturbed as per the Contract Documents prior to beginning Work. Clearing beyond the areas of construction shall be done only where specified or directed.

3.03 REMOVALS

A. Clear and grub the site specifically and grading limits as instructed on-site by the Director's Representative, of trees, shrubs, brush, other prominent vegetation, debris, four (4) old concrete exhibit platforms, and obstructions, except for those items indicated to remain per the Director's Representative. Completely remove stumps and roots protruding through the ground surface, unless directed otherwise within other sections of these specifications.

B. During the life of the contract the Director's Representative may order the clearing of any trees within the project that are determined to be hazardous, dead, or unsightly, or disfigured.

C. The Contractor shall carefully prune all branches of trees less than 14 feet above any part of the entrance drive and all branches which have been broken or injured during construction. The work shall be done to standard pruning practices.

D. Whenever trees are felled or trimmed on/or adjacent to the nearby visitor paved trail, all wood shall be immediately removed from the trail or any area that would present a hazard to the public or facility staff. Grubbed stumps shall be moved immediately at least 20 feet from the edge of pavement. No trees, tree trunks, stumps or other debris shall be felled, sidecast or left beyond the immediate construction area. Where trees or existing stumps are cleared and grubbing is not required, the tree trunk or existing stump shall be cut off not more than 3 inches above the original ground surface unless otherwise approved. Exposed stumps not required to be removed but which are within 5 feet of the edge of the pavement or are in a built-up area shall be chipped out to a depth of not less than 3 inches below the finished grade and the holes backfilled if directed by the Director's Representative. This Work shall be completed within one week after start of work on the tree.

B. Fill depressions caused by the clearing and grubbing operations in accordance with the requirements for filling and backfilling, unless further excavation is indicated.

3.03 DISPOSAL

A. All wood, stumps, and brush shall be disposed of off-site within 15 days after cutting or felling unless otherwise approved. No burning of land clearing materials that result from the clearing and grubbing operations, except in a permitted solid waste incinerator or as refuse derived fuel, will be permitted.

B. Chipping. Wood may be reduced to chips by the use of an approved chipping machine or stump grinder. Chips shall be 1/4” maximum thickness or of other approved thickness. Chips resulting from this activity shall be disposed of off-site and off of all park property.

C. Burying. No tree trunks, stumps or other debris shall be buried on-site.

END OF SECTION

SECTION 312000

EARTHWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Rock Removal: Section 312316

B. Clearing and Grubbing: Section 311100

B. Topsoil: Section 329100

1.03 DEFINITIONS

A. The following terms shall have the meanings ascribed to them in this Article, wherever they appear in this Section.

1. Earth Excavation: The removal of all surface and subsurface material not classified as rock (as defined below).

2. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which can be removed only by blasting operations, drilling, wedging, or use of pneumatic tools, and boulders with a volume greater than 1.0 cubic yard. Large stones/boulders used for sloped boulder walls and/or parapet stone setting, including those which may exceed the 1.0 cu. yard volume size shall **not** be classified as rock., nor quantified under rock removal. Concrete building foundations and concrete slabs, not indicated, with a volume greater than 1.0 cubic yard shall be classified as rock.

   a. Materials which can be loosened with a pick or backhoe, frozen materials, soft laminated shale or hardpan, pavements, curbs, and similar materials shall be classified as earth excavation. Concrete building foundations and concrete slabs, where indicated, shall be classified as earth excavation. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.

3. Sub-grade Surface: Surface upon which finish grade surface materials or topsoil is placed.

4. Sub-base: Select granular material or sub-base course which is placed immediately beneath finish surface materials, asphalt, or concrete slabs.

5. Maximum Density: The dry unit weight in pounds per cubic foot of the soil at "Optimum Moisture Content" when determined by ASTM D 698 (Method C), and ASTM D 2922 (Method B) as modified by NYS DOT in Manual STM-10.

6. Landscaped Areas: Areas not covered by structures, walks, roads, paving, or parking.

7. Unauthorized Excavation: The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Director's Representative.

1.04 SUBMITTALS

A. Samples: Shall be submitted as requested by the Director's Representative.

B. Quality Control Submittals:

1. Sub-base Materials: Name and location of source, stockpile number, and latest DOT test results and approval (if any). All aggregates are to conform to NYSDOT Section 703 Specifications.

2. Other Aggregates: Name and location of source, and latest DOT source number, test number, and date (if any).

3. Excavation Procedure: Submit a layout drawing or detailed outline of intended excavation procedure for the Director's information. This submittal will not relieve the Contractor of responsibility for the successful performance of intended excavation methods.

4. Sheeting, Shoring, and Bracing (Not shown on the Drawings): Submit a detailed plan of intended sheeting, shoring and bracing, signed by a New York State licensed Professional Engineer, for the Director's information. This submittal will not relieve the Contractor of responsibility for the successful performance of the intended sheeting, shoring and bracing methods.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect filter fabric from sunlight during transportation and storage.

1.06 PROJECT CONDITIONS

A. Protect existing trees and plants during performance of the Work unless otherwise indicated. Protect root systems from restricted air passage via compaction. Do not store excavated material, or allow vehicular traffic or parking within the branch drip line. Restrict foot traffic to prevent excessive compaction of soil over root systems.

B. Cold Weather Requirements:

1. When freezing temperatures are predicted, do not excavate to final required elevations for concrete Work unless concrete can be placed immediately. Retain enough earth over the bottom elevation of footings to prevent frost penetration. If excavation has progressed to final footing elevations and concrete cannot be placed immediately, cover the bottom of the excavations with protective material to adequately insulate the exposed earth surface from frost. Remove protective material immediately before placing concrete.

2. Do not backfill between November 1 and April 1, except with written permission of the Director's Representative.

C. Thru-traffic or fill placement with heavy construction vehicles or equipment which causes rutting or weaving to occur within the perimeter of a building will not be permitted. If rutting or weaving occurs during placement of fill, place specified fill in a stable area outside building perimeter and spread with tracked equipment to specified layer thickness.

PART 2 PRODUCTS

2.01 MATERIALS

A. Select Granular Material: Stockpiled, sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials. Comply with DOT Article 304-2 for Sub-base Course Type 4 material.

Sieve	Percent Passing
2 inch	100
1/4 inch	30-65
No. 40	5-40
No. 200	0-10

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after 4 test cycles.

2. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve shall not exceed 5.0.

3. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a 1/2 inch sieve shall consist of flat or elongated particles. A flat or elongated particle is defined as one which has its greatest dimension more than 3 times its least dimension.

B. Selected Fill: Sound, durable, sand, gravel, stone, or blends of these materials, free from organic and other deleterious materials.

Sieve	Percent Passing
4 inch	100
No. 40	0-70
No. 200	0-15

1. Plasticity Index: 15 or less

2. Particle size: 4 inch maximum

3. Gravel content: maximum 30% retained on ¾ inch sieve

C. Stonedust screenings: Screenings shall be 1/2 inch minus crushed rock screenings processed in a quarry, dark gray in color, consisting of hard, durable, sharp-edged

fragments free from dirt or other deleterious material, graded within the following limits:

SIEVE SIZE	% PASSING	ACCEPTABLE % RANGE
1/2”	99.5	95-100
3/8”	89.0	85-95
1/4"	70.2	60-75
#4	61.7	35-65
#8	44.8	
#10	41.7	
#16	33.6	20-40
#30	26.5	
#40	23.8	
#50	21.6	15-30
#60	20.6	
#100	17.6	
#200	13.3	10-15

1. Magnesium Sulfate Soundness Test: 20 percent maximum loss by weight after 4 test cycles.

2. Plasticity Index: The plasticity index of the material passing the No. 40 mesh sieve shall not exceed 5.0.

3. Elongated Particles: Not more than 30 percent, by weight, of the particles retained on a 1/2 inch sieve shall consist of flat or elongated particles. A flat or elongated particle is defined as one which has its greatest dimension more than 3 times its least dimension.

D. Suitable Material (Fill and Backfill for Landscaped Areas): Material consisting of mineral soil (inorganic), blasted or broken rock and similar materials of natural or man-made origin, including mixtures thereof. Maximum particle size shall not exceed 2/3 of the specified layer thickness prior to compaction. NOTE: Material containing cinders, industrial waste, sludge, building rubble, land fill, muck, and peat shall be considered unsuitable for fill and backfill, except topsoil and organic silt may be used as suitable material in landscaped areas provided it is placed in the top layer of the subgrade surface.

E. Filter Fabric (Separation, Drainage, Slope Protection): Amoco CEF 4545, CEF 4551; Exxon Chemical Co. GTF 150 EX; Mirafi Inc. 140N, 140NL; Nicolon Corp. Filterweave 70/06; Phillips Fibers Corp. Supac 4NP, 5NP, 7NP; Wellman Quline Inc. Q60, Q80, Q100.

F. Filter Fabric (Stabilization): Amoco CEF 2002 & 2006; Exxon Chemical Co. GTF 350; Mirafi Inc. 500X, 600X, 700X; Nicolon Corp. 500; Phillips Fibers Corp. Supac 3WS, 4WS, 5WS, 6WS; Wellman Quline Inc. Q160.

G. Cushion Material: Comply with the material requirements of DOT Article 703-06.

H. Underdrain Filter Material: One to one mixture of No. 2 and No. 3 coarse aggregate. Comply with DOT Article 703-02.

1. No. 2 Coarse Aggregate:

   Sieve Percent Passing

   1-1/2 inch 100
   1 inch 90-100
   1/2 inch 0-15

2. No. 3 Coarse Aggregate:

   Sieve Percent Passing

   2-1/2 inch 100
   2 inch 90-100
   1-1/2 inch 35-70
   1 inch 0-15

I. Crushed Stone, Crushed Gravel, or Screened Gravel: Comply with applicable portions of DOT Section 703-02, except as otherwise indicated.

   1. Gradation: No. 6 Sieve to 1/4 inch and 3/4 to 1-1/2 inches.

J. Sand Filter Material: Silica sand free from clay, loam, soft limestone or other impurities which may be disintegrated by sewage liquid.

   1. Organic Content: Less than 1 percent.

   2. Uniformity Coefficient: 4.0 or less.

   3. Shape: Rounded or oval. Do not use sharp sand, crushed flint or gravel.

   4. Effective Size: 0.50 to 1.0 mm

PART 3 EXECUTION

3.01 REMOVAL OF TOPSOIL

A. Remove existing topsoil and all unsuitable material from areas within the grading limits where excavation or fill is required.

B. Stockpile approved topsoil where directed until required for use. Place, grade, and shape stockpiles for proper drainage, and surround with silt fencing if to remain in-place greater than a 2-week period. Unsuitable material should be removed from the site.

   1. Topsoil shall be tested prior to stockpiling. Stockpile only quantities of topsoil approved in writing for re-use. Dispose of excess topsoil as specified.

3.02 UNDERGROUND UTILITIES

A. Verify that the location of existing underground utilities and service connections prior to commencing excavation Work. Determine exact utility locations by hand excavated test pits. Support and protect utilities to remain in place.

B. Remove inactive, abandoned utilities within the limits of the areas to be excavated. Cap or plug open ends of abandoned utilities extending outside the excavation limits.

3.03 EXCAVATION

A. Excavate earth as required for the Work.

B. Maintain sides and slopes of excavations in a safe condition until completion of backfilling. Comply with Code of Federal Regulations Title 29 - Labor, Part 1926 (OSHA).

1. Trenches: Deposit excavated material on one side of trench only. Trim banks of excavated material to prevent cave-ins and prevent material from falling or sliding into trench. Keep a clear footway between excavated material and trench edge. Maintain areas to allow free drainage of surface water.

C. Stockpile excavated materials classified as suitable material where directed, until required for fill. Place, grade, and shape stockpiles for proper drainage as approved by the Director's Representative.

D. Excavation for Structures: Conform to elevations, lines, and limits indicated. Excavate to a vertical tolerance of plus or minus 1 inch. Extend excavation a sufficient lateral distance to provide clearance to execute the Work.

E. Footings and Foundations: Trim bottoms to required lines and elevations. Excavate to final elevations by hand just prior to concrete placement when concrete is to bear on undisturbed soil.

1. Stepping Footings: Cut sloping surfaces under footings, foundations, steps, and where required for other Work as indicated.

2. Pile Foundations: Stop excavations 6 to 12 inches above the bottom of pile cap elevation before the piles are placed. After pile installation, remove loose and displaced material and excavate to final grade, leaving a solid base to receive concrete pile caps.

3. Where footings and other Work requiring similar soil support will rest entirely on rock, remove loose soil and loose rock and place concrete to the required elevations. Where footings and other Work requiring similar soil support will rest partially on rock and partially on soil, immediately notify the Director’s Representative before any backfilling or concrete placement occurs; the Director’s Representative will determine the correct foundation treatment for the Work.

F. Slabs and Floors: Excavate to the following depths below bottom of concrete for addition of select granular material:

1. Interior Floors: 6 inches unless otherwise indicated.

2. Exterior Slabs and Steps: 12 inches unless otherwise indicated.

G. Pipe Trenches: Open only enough trench length to facilitate laying pipe sections. Unless otherwise indicated on the Drawings, excavate trenches approximately 24

inches wide plus the outside pipe diameter, equally divided on each side of pipe centerline. Cut trenches to cross section, elevation, profile, line, and grade indicated. Accurately grade and shape trench bottom for uniform bearing of pipe in undisturbed earth. Excavate at bell and coupling joints to allow ample room for proper pipe connections.

1. Trench in Rock: Excavate an additional 6 inches below bottom of pipe for bed of cushion material under the piping.

H. Open Ditches: Cut ditches to cross sections and grades indicated.

I. Pavements and vehicular access ways: Excavate to sub-grade surface elevation.

J. Unauthorized Excavations: Unless otherwise directed, backfill unauthorized excavation under footings, foundation bases, and retaining walls with compacted select granular material without altering the required footing elevation. Elsewhere, backfill and compact unauthorized excavation as specified for authorized excavation of the same classification, unless otherwise directed by the Director.

1. Unauthorized excavations under structural Work such as footings, foundation bases, and retaining walls shall be reported immediately to the Director before any concrete or backfilling Work commences.

K. Notify the Director's Representative upon completion of excavation operations. Do not proceed with the Work until the excavation is inspected and approved. Inspection of the excavation by the Director's Representative will be made on 3 working days notice.

L. Removal of Unsuitable Material Beneath Structures and Other Improvements:

1. The exposed subgrade should be proof-rolled to delineate unstable areas. The proof-rolling should be done after a suitable period of dry weather to avoid degrading the subgrade The proof-rolling equipment should consist of a heavily-loaded dump truck or similar equipment acceptable to the director’s representative. The proof-rolling equipment should make several passes over each section of the subgrade.

2. Excavate encountered unsuitable materials, which extend below required elevations, to additional depth as directed by the Director’s Representative. Have cross sections taken, under the supervision of an independent Land Surveyor, to determine the quantity of such excavation. Do not backfill this excavation prior to quantity measurement.

3. Such additional excavation and backfilling, not due to error, fault or neglect of the Contractor will be paid for using allowance monies. Backfilling shall take place in these areas using acceptable fill previously specified.

3.04 DEWATERING

A. Prevent surface and subsurface water from flowing into excavations and trenches and from flooding the site and surrounding area.

B. Do not allow water to accumulate in excavations, trenches or subgrade areas. Remove water from all excavations immediately to prevent softening of foundation

bottoms, undercutting footings, and soil changes detrimental to the stability of sub-grades and foundations. Furnish and maintain pumps, sumps, suction and discharge piping systems, and other system components necessary to convey the water away from the Site.

C. Convey water removed from excavations, and rain water, to collecting or run-off area. Cut and maintain temporary drainage ditches and provide other necessary diversions outside excavation limits for each structure. Do not use trench excavations as temporary drainage ditches.

D. Provide temporary controls to restrict the velocity of discharged water as necessary to prevent erosion and siltation of receiving areas.

3.05 SETTLEMENT DETECTION

A. Establish a settlement detection method approved by the Director's Representative for structures subject to settlement from excavation, sheeting or sheetpiling operations. Maintain surveillance to detect any settlement.

3.06 PLACING FILTER FABRIC

A. Place and overlap filter fabric in accordance with the manufacturer's installation instructions, unless otherwise shown.

B. Cover tears and other damaged areas with additional filter fabric layer extending 3 feet beyond the damage.

C. Do not permit traffic or construction equipment directly on filter fabric.

D. Backfill over filter fabric within two weeks after placement. Backfill in accordance with the fabric manufacturer's instructions and in a manner to prevent damage to the fabric.

3.07 PLACING FILL AND BACKFILL

A. Surface Preparation of Fill Areas: Strip topsoil, remaining vegetation, and other deleterious materials prior to placement of fill. Break up or scarify old pavements to a maximum of 2 square feet. Prior to placement of fill, smooth out and compact areas where wheel rutting has occurred due to stripping or earthwork operations.

B. Excavations: Backfill as promptly as Work permits, but not until completion of the following:

1. Acceptance by the Director's Representative of construction below finish grade including, where applicable, damp-proofing, waterproofing, perimeter insulation, and bearing capacity of supporting soil.

2. Inspection, testing, approval, and recording locations of under- ground utilities.

3. Removal of concrete formwork.

C. Place backfill and fill materials in layers not more than 8 inches thick in loose depth unless otherwise specified. Before compaction, moisten or aerate each layer as necessary to facilitate compaction to 95% of ASTM D698 (standard Proctor).

Compaction moisture content range to be between +/- 2 percent of optimum. Do not place backfill or fill material on surfaces that are muddy, frozen, or covered with ice.

1. Place fill and backfill against foundation walls, and in confined areas (such as trenches) not easily accessible by larger compaction equipment, in maximum 6-inch thick (loose depth) layers.

2. For large fill areas, the layer thickness may be modified by the Director's Representative, at the Contractor's written request, if in the Director's Representative's judgment, the equipment used is capable of compacting the fill material in a greater layer thickness. This request shall include the type and specifications of compaction equipment intended for use.

D. Prevent wedging action of backfill against structures by placing backfill uniformly around structure to approximately same elevation in each layer. Place backfill against walls of structures containing basements or crawl spaces only after the first floor structural members are in place.

E. Foundation Drains:

1. Line pipe trench loosely with filter fabric. Lap successive sheets 18 inches.

2. Place underdrain filter material a minimum of 4 inches deep under pipe and 6 inches on both sides and over top of drain pipe.

3. Wrap filter fabric over filter material and lap 12 inches.

4. Within two weeks complete balance of backfill with selected fill extending 2 feet out from foundation wall and up to 6 inches below finished grade.

F. Perimeter Insulation: Before the insulation is installed, place and tamp specified backfill to a smooth plane even with the required elevation of the lower surface of the insulation.

G. Under Exterior Concrete Slabs and Steps:

1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.

2. Subbase Material: unless otherwise noted on the Drawings, place 12 inches of select granular material over subgrade surface.

H. Under Interior Concrete Slabs:

1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.

2. Subbase Material: Unless otherwise noted on the Drawings, place 6 inches of select granular material over subgrade surface.

I. Under Pavements and Walks:

1. Up to Subgrade Surface Elevation: Place selected fill when fill or backfill is required.

2. Subbase Material: Place as indicated on the Drawings.

J. Landscaped Areas: Place suitable material when required to complete fill or backfill areas up to subgrade surface elevation. Do not use material containing rocks over 4 inches in diameter within the top 12 inches of suitable material.

K. Pipe Tunnels: Place selected fill a minimum of 12 inches on both sides and over top of tunnel.

L. Plastic Pipe and Cement Water Pipe in Trenches: Place cushion material a minimum of 4 inches deep under pipe, 4 inches on both sides, and 4 inches above top of pipe. Complete balance of backfill as specified.

1. Trench in Rock: Place a minimum 6-inch deep bed of cushion material under pipe.

M. Copper Tubing and Steel Gas Pipe in Trenches: Place cushion material a minimum of 6 inches deep under pipe, 6 inches on both sides, and 4 inches above top of pipe. Complete balance of backfill as specified.

N. Backfilling Excavation Resulting from Removal of Unsuitable Material Beneath Structures and Other Improvements: Backfill the excavation with compacted select granular material.

1. Such additional backfilling, exceeding the numeric quantities indicated on the Drawings, is included in the unit prices specified in this Section.

3.08 COMPACTION

A. Compact each layer of fill and backfill for the following area classifications to the percentage of maximum density specified below and at a moisture content suitable to obtain the required densities, but at not less than 3 percent drier or more than 2 percent wetter than the optimum content as determined by ASTM D 698.

1. Structures (entire area within 10 feet outside perimeter): 95 percent.

2. Concrete Slabs and Steps: 95 percent.

3. Landscaped Areas: 90 percent.

4. Pavements and Walks: 95 percent.

5. Pipes and Tunnels: 95 percent.

6. Pipe Bedding: 95 percent.

B. When the existing ground surface to be compacted has a density less than that specified for the particular area classification, break up and pulverize, and moisture condition to facilitate compaction to the required percentage of maximum density.

C. Moisture Control:

1. Where fill or backfill must be moisture conditioned before compaction, uniformly apply water to the surface and to each layer of fill or backfill. Prevent ponding or other free water on surface subsequent to, and during compaction operations.

2. Remove and replace, or scarify and air dry, soil that is too wet to permit compaction to specified density. Soil that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing, until moisture content is reduced to a value which will permit compaction to the percentage of maximum density specified.

3.09 ROUGH GRADING

A. Exterior Grading: Trim and grade area within the grading limits required by this Contract, to a level of 4 inches below the finish grades indicated unless otherwise specified herein or where greater depths are indicated. Provide smooth uniform transition to adjacent areas.

1. Slope cut and fill in transition areas, outside of the grading limit line, to meet corresponding levels of existing grades at a slope of 1 vertical to 2 horizontal unless otherwise indicated.

2. Landscaped Areas: Provide uniform subgrade surface within 1 inch of required level to receive topsoil thickness specified. Compact fill as specified to within 3 inches of subgrade surface. Remove objectionable material detrimental to proper compaction or to placing full depth of topsoil. If the top 3 inches of subgrade has become compacted before placement of topsoil, harrow or otherwise loosen rough graded surface to receive topsoil to a depth of 3 inches immediately prior to placing topsoil.

3.10 SUBGRADE SURFACE FOR WALKS, PAVEMENT, AND VEHICULAR ACCESSWAYS

A. Shape and grade subgrade surface as follows:

1. Walks/zookeeper paths: Shape the surface of areas under walks to required line, grade and cross section, with the finish surface not more than 1 inch above or below the required subgrade surface elevation.

2. Pavements: Shape the surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subgrade surface elevation.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Thoroughly compact subgrade surface for walks and pavement by mechanical rolling, tamping, or with vibratory equipment as approved to the density specified.

D. Shoulders: Place shoulders along edges of filled subgrades to prevent lateral movement. Construct shoulders of selected fill material, placed in such quantity to compact to thickness of each subgrade course layer. Compact and roll at least a 2'-0" wide additional layer of each subgrade course.

3.11 FINISH GRADING

A. Uniformly grade rough graded areas within limits of the Grading Limit Line to finish grade elevations indicated.

B. Grade and compact to smooth finished surface within tolerances specified, and to uniform levels or slopes between points where finish elevations are indicated or between such points and existing finished grade.

C. Grade areas adjacent to building lines so as to drain away from structures and to prevent ponding.

D. Finish surfaces free from irregular surface changes, and as follows:

1. Landscape Areas: Finish areas to receive topsoil to within 1 inch above or below the required subgrade surface elevations.

2. Walks/Zookeeper Paths: Place and compact subbase material as specified. Shape surface of areas under walks to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.

3. Pavements: Place and compact subbase material as specified. Shape surface of areas under pavement to required line, grade and cross section, with the finish surface not more than 1/2 inch above or below the required subbase elevation.

4. Building Slabs: Grade subbase material smooth and even, free of voids, compacted as specified, and to required subbase elevation. Finish final grades within a tolerance of 1/4 inch when tested with a 10-foot straightedge.

E. Spread topsoil directly upon prepared subgrade surface to a depth measuring 4 inches after natural settlement of the topsoil has occurred. Place to greater depth when necessary to adjust grades to required elevations.

1. Approved existing topsoil within the Grading Limit Line may be used. Provide additional topsoil from approved outside sources as required.

F. Finish topsoil surface free of depressions which will trap water, free of stones over 1 inch in any dimension, and free of debris.

3.12 MAINTENANCE AND RESTORATION

A. Restore grades to indicated levels where settlement or damage due to performance of the Work has occurred. Correct conditions contributing to settlement. Remove and replace improperly placed or poorly compacted fill materials.

B. Restore pavements, walks, curbs, and other exterior surfaces damaged during performance of the Work to match the appearance and performance of existing corresponding surfaces as closely as practicable.

3.13 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS

A. Remove from State property and dispose of excess and unsuitable materials, including materials resulting from clearing and grubbing and removal of existing improvements.

B. Transport excess topsoil to areas on State property designated by the Director's Representative. Smooth grade deposited topsoil.

3.14 FIELD QUALITY CONTROL

A. Compaction Testing: Notify the Director's Representative at least 3 working days in advance of all phases of filling and backfilling operations, so fill activities may be monitored and observed. Compaction testing will be performed by the Director's Representative to ascertain the compacted density of the fill and backfill materials, and to the following standards;
   1. Large fill areas: 1 test per 2000 square feet for each 1 ft. thick fill lift.
   2. Confined fill areas: 1 test per 20 cubic yards.
   3. Minimum requirement: 2 tests per 1 foot thick fill lift.
   4. Acceptable testing methods to determine field dry density are the Sand Cone Test (ASTM D1556-90) or Nuclear Density (ASTM D2292-91).

B. Compaction testing will be performed on certain layers of the fill and backfill as determined by the Director's Representative. If a compacted layer fails to meet the specified percentage of maximum density, the layer shall be recompacted and will be retested. No additional material may be placed over a compacted layer until the specified density is achieved.

3.15 PROTECTION

A. Protect graded areas from traffic and erosion,and keep them free of trash and debris.

END OF SECTION

SECTION 312316

ROCK REMOVAL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 312000
B. Cast-in-place Concrete-Sitework: Section 033001

1.03 UNIT PRICES FOR ADDED OR DEDUCTED WORK

A. Measurement: Rock quantities shall be determined by measuring rock in place prior to removal. Measurements shall be taken of the actual rock cut, as required for the Work, or to the specified measurement limits, whichever is smaller. The engineer's estimate prepared for this work estimates that approximately **50 cubic yards** of rock removal shall be required to complete the work. If greater or less cubic yard quantities of rock removal are incurred during the course of the work, a fixed unit cost **$150 per cu. yard** will be used to quantify associated costs, to which additional or reduced costs shall be paid or deducted from the contract amount.

B. Large stones/boulders used for retaining walls and/or exhibit rockwork, including those which may exceed the specified 1.0 cu. yard volume size shall **not** be classified as rock, nor quantified or counted under rock removal.

Unless otherwise directed in writing, measurement limits shall be as follows:

1. Pathways and Roadways

   a. Vertical Limit: Bottom of rock cut shall be 6 inches below finish grade as identified in the field by the Director's Representative during layout and grading operations.

   b. Horizontal Limit: Limit measurement will be two feet outwards from the edge of vehicular use areas.

2. Cast-In-Place Concrete (excludes sidewalks and concrete pads):

   a. Vertical Limit: Bottom of rock cut for cast-in-place concrete bearing on rock shall be the bottom of concrete elevation indicated on the Drawings.

b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth Of Rock Cut	Distance Beyond Edge Of Concrete In Each Direction
Under 3 Feet	18 Inches
3 To 15 Feet	24 Inches
Over 15 Feet	30 Inches

3. Precast Concrete Structures: Measurement will be based on the size of the precast concrete structure specified or indicated on the Drawings.

   a. Vertical Limit: Bottom of rock cut for precast concrete structure shall be 12 inches below the required bottom of structure elevation.

   b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth Of Rock Cut	Distance Beyond Edge of Structure In Each Direction
Under 5 Feet	12 Inches
5 To 15 Feet	18 Inches
Over 15 Feet	24 Inches

4. Pipe:

   a. Vertical Limit: Bottom of rock cut for pipe in trench shall be 6 inches below the required pipe invert elevation, with depth measured from the mean surface of the rock.

   b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth Of Rock Cut	Trench Width
Under 10 Feet	24 Inches Plus Pipe OD
10 To 15 Feet	36 Inches Plus Pipe OD
Over 15 Feet	48 Inches Plus Pipe OD

5. Conduit:

   a. Vertical Limit: Bottom of rock cut for conduit in trench shall be as required for the indicated depth of the conduit.

   b. Horizontal Limit: Limit measurement between vertical side surfaces at bottom of rock cut to the following:

Actual Depth	Trench Width

Of Rock Cut	
Under 3 Feet	24 Inches, except where wider width is required by the multiple horizontal conduits.
3 To 10 Feet	36 Inches, except where wider width is required by the Drawings or directed for multiple horizontal conduits.

1.04 REFERENCES

A. Comply with the applicable requirements of the Code of Federal Regulations Title 29 - Labor, Part 1926 Safety and Health Regulations for Construction (OSHA).

1.05 DEFINITIONS

A. Rock: Limestone, sandstone, shale, granite, and similar material in solid beds or masses in its original or stratified position which can be removed only by blasting operations, drilling, wedging, or use of pneumatic tools, and boulders with a volume greater than 1.0 cu yd, excepting those used for parapet stone setting and sloped boulder wall. Concrete building foundations and concrete slabs, not indicated, with a volume greater than 1.0 cu yd shall be classified as rock.

1. Materials which can be loosened with a pick or backhoe, frozen materials, soft laminated shale or hardpan, pavements, curbs, and similar materials shall be classified as earth excavation. Concrete building foundations and concrete slabs, where indicated, shall be classified as earth excavation. Masonry building foundations, whether indicated or not, shall be classified as earth excavation.

B. Unauthorized Rock Removal: The removal of material below required elevation indicated on the Drawings or beyond lateral dimensions indicated or specified without specific written direction by the Director.

C. General Rock Removal: Quantities of rock removal will be paid for as General Rock Removal when:

1. The width of rock removed, as per measurement limits, is greater than or equal to the total excavation depth required.

2. Boulders removed have a volume greater than 1.0 cu yd. (see rest of spec. for exceptions)

D. Trench and Pier Rock Removal: Quantities of rock removal will be paid for as Trench and Pier Rock Removal when the width of rock removed, as per measurement limits, is less than the total excavation depth required.

1.06 SUBMITTALS

A. Rock Removal Procedure: Submit a detailed outline of intended rock removal procedure for the Director's information. This submittal will not relieve the Contractor of responsibility for the successful performance of method used.

1. Blasting shall not be permitted, unless clearly indicated to the Director's Representative that the rock cannot be removed through mechanical means.

B. Quality Control Submittals:

1. Certificates: Competency affidavit required under Quality Assurance Article.

2. Blasters Qualifications Data (if necessary): Submit the following for each blaster:

a. Name, and employer's name, business address and telephone number.

b. Names and addresses of the required number of similar projects which meet the experience criteria.

C. Measurement data for quantities of rock removal.

1.07 QUALITY ASSURANCE

A. Blasters' Qualifications (if necessary): The persons performing the blasting operations shall be personally experienced in the handling and use of explosives, shall furnish satisfactory evidence of competency in performing in a safe manner the type of blasting required, and shall have performed blasting operations on 5 similar projects.

B. Regulatory Requirements: Obtain the proper Permit to Blast from authorities having jurisdiction before explosives are bought to the site.

C. Certifications: Affidavit, for each blaster, certifying that blaster is competent in performing the type of blasting required.

C. Pre-Rock Removal Conference: Before the rock removal work is scheduled to commence, a conference will be called by the Director's Representative at the site for the purpose of reviewing the Contract Documents and discussing requirements for the Work. The conference shall be attended by the Contractor's Representative and the person supervising the rock removal operations.

PART 2 PRODUCTS

2.01 MATERIALS

A. Backfill Materials and Other Related Earthwork: As specified in Section 312000

PART 3 EXECUTION

3.01 EXAMINATION

A. Examination of Existing Property and Construction: Prior to starting rock removal Work, thoroughly examine the existing property and construction at the site and record, with notes and drawings or other documentation, existing defects and deterioration. Make this information available to the Director's Representative upon request.

3.02 PREPARATION

A. Excavate test pits as required in Paragraph 1.02 B.

3.03 ROCK REMOVAL

A. Remove rock as required by the Drawings and as necessary for the installation of the Work. Make sufficient clearance, within the limits specified, for the proper execution of the Work.

3.04 FIELD QUALITY CONTROL

A. Allow time for visual inspection of bottom of rock cut required for the Work.

3.05 DISPOSAL OF EXCESS AND UNSUITABLE MATERIALS.

A. Remove from State property and dispose of excess and unsuitable rock materials unless otherwise directed by the Director’s Representative. If allowed, transport same to spoil areas on State property as designated by the Director's Representative, and dispose of such materials as directed

3.06 ADJUSTING

A. Unauthorized Rock Removal:

1. Horizontal Direction: Backfill and compact unauthorized rock removal in the horizontal direction as specified for authorized excavation of the same classification, unless otherwise directed.

2. Vertical Direction: Immediately report unauthorized rock removal in the vertical direction to the Director's Representative. Correct unauthorized rock removal in the vertical direction in accordance with directions of the Director.

3.07 CLEANING

A. Where footings and walls will rest entirely on rock, clean rock surfaces free of soil and loose rock.

END OF SECTION

SECTION 313720

LANDSCAPE STONE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 312000.

PART 2 PRODUCTS

2.01 STONE

A. Contactor shall provide sound, durable, rock complying with the following requirements:

1. Any boulder rock, decorative gravel, or stone slabs imported to site shall exhibit stone colors indigenous to the area. Submit at least three (3) 12 in. samples of rock to be used that are representative of rock color for approval by the Director's Representative. All rocks shall remain free of machine-made scratches, mars, or other damage to the visible faces.

B. Any boulder rock necessary for the work discovered from on-site excavations may be used for the work at the approval of the Director's Representative.

C. Contractor shall provide the location of stone sample(s) for review and approval by the Director's Representative.

PART 3 EXECUTION

3.01 PREPARATION

A. The Director's Representative shall be notified two weeks before the stone is to be delivered to the construction site.

B. All stone chosen shall be protected from chipping and scarring during transportation and final setting to preserve it natural weathered state.

C. Contractor shall mark out the location of boulders based on the contract documents and the for approval of the Directors Representative.

D. All areas scheduled for stone placement shall have been cleared and grubbed to applicable standards. Contractor shall ensure that all organic matter, including tree stumps and associated have been removed from areas where the stone shall be

set.

3.03 STONE INSTALLATION

A. The Director's Representative will direct the placement of boulders in the field. Spacing and location of the boulders shall be as shown on plans, or as instructed by the Director's Representative. The Contractor shall make adjustments in the stone placement as directed. After the arrangement of stone is approved, the Contractor shall set the boulders in place and backfill around them with bedding material.

B. The placed stone shall be clean, free from marks or scars caused by construction equipment and in a stable position that prevents future displacement.

C. Payment will not be make for installed stonework that is not accepted by the Director's Representative, or has degraded due to material failure, or improper storage of material.

END OF SECTION

SECTION 313730

NATIVE STONE BOULDERS – ALTERNATE #2

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Section 312000 - Earthwork
B. Section 088100 0 Exterior Glass – Alternate #2

1.02 SUMMARY

A. This work shall consist of loading and transporting 35 stone boulders approximately 1 to 3 tons each in size which are located within a 10 miles of the project site. Contractor will deliver and install these boulders as instructed by the Director's Representative.

B. The owner supplied stone will be used as shown on the drawings and details as instructed by the Director's Representative for:

   1. Porcupine Stone Slab Barrier

C. Contractor may furnish and place new boulders, if preferred, but the Director's Representative must approve these items.

PART 2 PRODUCTS –
2.01 MATERIALS

A. If Contractor decides to purchase stone instead of using owner supplied stone, the Contractor shall provide the location of stone sample(s) for review and approval by the Director's Representative.

PART 3 EXECUTION

3.01 PREPARATION

A. The Director's Representative shall be notified two weeks before the stone is to be delivered to the construction site.

B. All stone chosen shall be protected from chipping and scarring during transportation and final setting to preserve it natural weathered state.

C. Contractor shall mark out the location of boulders based on the contract documents and the for approval of the Directors Representative.

D. All areas scheduled for stone placement shall have been cleared and grubbed to applicable standards. Contractor shall ensure that all organic matter, including tree stumps and associated have been removed from areas where the stone shall be set.

3.03 STONE INSTALLATION

A. The Director's Representative will direct the placement of boulders in the field. Spacing and location of the boulders shall be as shown on plans, or as instructed by the Director's Representative. The Contractor shall make adjustments in the stone placement as directed. After the arrangement of stone is approved, the Contractor shall set the boulders in place and backfill around them with bedding material.

B. The placed stone shall be clean, free from marks or scars caused by construction equipment and in a stable position that prevents future displacement.

C. Payment will not be make for installed stonework that is not accepted by the Director's Representative, or has degraded due to material failure, or improper storage of material.

D. Contractor will be responsible to repair any damage at the off site storage location that occurs during the loading and transporting of the stone.

END OF SECTION

SECTION 321243

POROUS FLEXIBLE PAVING

PART 1 GENERAL

1.00 GENERAL PROVISIONS

A. Drawings and general provisions including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this Section.

1.01 WORK INCLUDED

A. Provide labor, materials and equipment necessary to complete the work of this Section, including but not limited to the following:

1. Porous Flexible Paving made from recycled passenger tires, crushed stone and a urethane binding agent.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 312000, EARTHWORK.

1.03 REFERENCES

A. The Contractor is responsible for supplying and installing a warranted material that meets, or exceeds, the manufacturer's specifications and testing:

1. ASTM C 666/C/666M- Freeze-Thaw testing with no cracks or breaks through 300 cycles of testing.
2. Designated as "Highly Permeable" under FL DOT FM 5-565 permeability testing.
3. Independent testing showing a perk rate of 2400 gph (40 gpm) per sq. ft. or higher.
4. Scuff/Power Steering Resistance in accordance with ISSA TB 100 / ISSA TB 139.
5. Accelerated Weathering using ASTM 4798.
6. Hamburg Loaded Wheel Testing TX DOT 242-F must be equivalent or better than 2.3 rut depth at 8,000 cycles and full recovery within 24 hours.
7. Static Creep Testing TX DOT 231-F shall be equivalent to or better than total strain +2.703% and permanent strain equal to 0.514%.
8. Resilient Modulus Testing in accordance with ASTM D 4123 shall be equivalent or better than 68,495 pounds.
9. Slip resistant and ADA compliant, in accordance with ASTM D 2047 testing.
10. Heat resilient to 400 degrees in accordance with ASTM D 4123 testing.
11. Sound absorbent, in accordance with ASTN C423-09a / E795-05 testing.
12. Compression tested and be able to withstand 250 psi without permanent deformation or damage.
13. Has a leachate less than 6 parts per billion and containing no organic compounds or heavy metals.
14. The material shall be resistant to the following elements: transmission, hydraulic, and brake fluids, gasoline, diesel, saltwater, oil, chlorine, ozone, bromine, and muriatic acid.

1.04 SUBMITTALS

A. The Installer shall submit;

1. Certificates stating that materials meet or exceed the specified contract requirements.
2. Site handling and storage instructions.
3. Mixing and installation instructions.
4. A 4' x 4' sample that reflects the characteristics of the material to be installed. The sample, upon approval, shall be maintained as the standard of minimum quality for all the proposed surfacing and paving work required for the project.
5. Certificate stating percentage of recycled content.

1.05 QUALITY ASSURANCE

A. The Porous Flexible Paving shall be supplied by a manufacturer with at least 10 years of experience that can supply references for similar applications and installations in the USA. Pre-approved suppliers include but are not limited to:

1. K.B. Industries, Inc. (KBI), 4600 140th Ave. N, Suite 200, Clearwater, FL 33762. Tel: 727 723 3300.

B. Installers should have at least 5 years of experience and can supply references for similar applications and installations in the USA. Pre-approved installers include but are not limited to:

1. Tri State FlexiPave, Contact Henri Hillman
   Office: 203 628 7613, Cell: 914 874 3988
2. Environmental Paving Solutions, LLC. 6701 Thompson Road, Syracuse, New York 13211. Tel: 315 472 6902

C. The Contractor's craftsmen or crew chief, installing the Porous Flexible Paving shall attend a Manufacturer's training webinar and an on-site installation training session prior to installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Geotextile filter fabric, per Porous Flexible Paving manufacturers recommendation.

B. Geocell Soil Stabilization System

1. For load bearing applications a 6" geocell soil stabilization system shall be installed to retain and support the crushed stone sub-base.
2. Recommended Geocell Soil Stabilization Systems include, but are not limited to:
   a. GEOWEB Geocells
      Presto Geosystems. 670 N Perkins Street, PO Box 2399 Appleton, Wisconsin USA 54912. Tel: 920.738.1328

C. Crushed Stone

1. 3/4", ASTM 57, clean crushed stone. Refer to contract drawings for depth.

D. Heavy Duty L-shaped Edge Restraint

1. To retain the Porous Flexible Pavement, a L-shaped edge restraint shall be used on all edges not adjacent to existing pavement.

2. Recommended Heavy Duty L-shaped Edge Restraints include, but are not limited to:
   a. Curv-Rite 4000 series
      Curv-Rite Aluminum Edging. Wayland, MI USA. Tel: 800-366-2878

E. Porous Flexible Pavement.

1. The Porous Flexible Pavement shall have a composition of 50% stone aggregate and 50% chipped rubber tires by weight for trails, carts paths, sidewalks and tree surrounds. For vehicular applications, such as driveways and parking lots, the composition shall be 50% stone aggregate and 50% chipped rubber tires by volume.
2. The Porous Flexible Pavement shall be mixed with a urethane binding agent based on MDI Polyether Polyols and shall be free of extender oils to prevent leaching over time. Binders that use extender oils will not be acceptable.
3. The Porous Flexible Pavement shall be cured and fit for use within 24 hours of installation.
4. The Porous Flexible Pavement shall be natural colors; Cypress / Redwood / Bark Brown / Green / Granite or Black in color. Final color selection to be determined by Director's Representative.

F. All components, materials and compounds shall be 100% sourced and manufactured within the USA.

PART 3 EXECUTION

3.01 PROJECT CONDITIONS

A. The Contractor shall provide appropriate and adequate protection to adjacent areas including but not limited to:

1. Protection of adjacent work space from splashing of Porous Flexible Paving materials.
2. Remove all stains from exposed surfaces of paving, structures, and grounds.
3. Remove all waste and spillage.
4. Provide suitable protection to assure no damage or disturbance to existing improvements or vegetation before starting work and maintain protection throughout the course of the work
5. Restore and repair areas, at no additional cost to the owner, that have been damaged as a result of construction work, including existing paving on or adjacent to the site, to their original condition or repair as directed to the satisfaction of the Director's Representative.

3.02 WEATHER

A. Porous Flexible Pavement urethane binder is engineered based on the geographical location of the project and climate expectations during installation. Manufacturer will provide the appropriate binder for each installation and the materials delivered will be based on project location and seasonality.

B. Porous Flexible Pavement shall not be installed when the ambient air temperature in the shade near the installation site is above 95° F or below 32° F. Temperatures below 50° F can extend the curing time and would fall outside of normal "use ready in 24 hours" guidelines.

C. The urethane binder shall be stored on site at between 40°- 77° F and used within 12 months of delivery.

D. The Contractor shall not pave on days when rain or snow is forecast, unless a change in the weather results in favorable paving conditions as determined by the Director's Representative.

E. In the event of rain on days prior to installation, the sub-base must be dry and not contain any standing or moving water.

3.03 SAFETY AND TRAFFIC CONTROL

A. When construction work will interfere with existing, traffic and sidewalks the Contractor shall notify and cooperate with local authorities, and other jurisdictional organizations, and provide temporary barriers, signs, warning lights, flaggers, and other protections as required by the authorities to assure the safety of pedestrians and vehicles around the construction area and to organize the smooth flow of traffic.

3.04 GRADING

A. Areas to be paved will be compacted and brought approximately to subgrade elevation under work performed by others under separate contract with the Owner before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.

B. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 1 in. deep in subgrade, shall be graded out, reshaped, and recompacted before placing pavement.

C. Materials shall not be stored or stockpiled on subgrade.

3.05 SUB-BASE PREPARATION

A. Install filter fabric as shown in the contract drawings.

B. Install Geocell Soil Stabilization System where load bearing capabilities are required. Refer to contract drawings.

C. Install Crushed Stone with a minimum 96% compaction. Refer to contract drawings for depth of crushed stone.

3.06 POROUS FLEXIBLE PAVING

A. Furnish all labor, materials, tools, equipment, and incidentals required to install Porous Flexible Pavement.

B. Provide an adequate number of skilled workers who are trained and experienced with installing Porous Flexible Pavement and are familiar with the specified contract requirements and the methods needed for its installation.

C. Install the crushed stone sub-base as described in the specifications and shown on the contract drawing unless the sub-base is installed/provided.

D. Install the Porous Flexible Pavement to depth and width as described in the specifications and shown in the contract drawings.

E. Reduce the risk of damage to the Porous Flexible Paving surface by not allowing track vehicles (metal or rubber), forklifts (warehouse-variable reach), main lifts (booms or scissors), and/or dumpsters or roll-off containers on the Porous Flexible Pavement either during or following installation. Any explicit or implied warranty is voided through failure to comply with this section.

3.07 MAINTENANCE

A. Porous Flexible Pavement installations are designed to operate and function trouble free with only minimal routine maintenance over the lifetime of the product.

B. The frequency and scope of the routine maintenance required will largely be dependent on the application and project location. The key objective will be to keep the surface clean and clear of debris to maintain the hydraulic conveyance capacity of Porous Flexible Pavement over time as well as maintaining the aesthetic appeal of the surface.

C. Prior to undertaking routine maintenance of Porous Flexible Pavement, it is recommended that an annual inspection be completed to evaluate the condition of the surface. The following are suggested annual maintenance inspection points:

1. Inspect the surface of the Porous Flexible Pavement for evidence of sediment deposition, organic debris, staining or ponding. If any signs of clogging are noted, schedule a vacuum sweeper (no brooms or water spray) to remove deposited material. Cleaned sections may then be tested by pouring water from a five-gallon bucket to ensure full hydraulic conveyance capacity has been restored.
2. Inspect the structural integrity of the Porous Flexible Pavement surface, looking for signs of damage or surface deterioration, such as raveling, slumping, cracking, etc. Replace or repair affected areas, as necessary.
3. Check for potential need to overspray/roll with urethane binder after 4-6 years.

D. If in doubt or should any unexpected situations or observations occur during the maintenance inspection, please contact the Manufacturer for consultation and advice.

END OF SECTION 321243

SECTION 321313

PORTLAND CEMENT CONCRETE PAVING

PART 1 GENERAL

1.00 GENERAL PROVISIONS

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

1.01 WORK INCLUDED

A. Provide all equipment and materials and do all work necessary to construct the Portland cement concrete paving work, as indicated on the Drawings and as specified.

1.02 RELATED WORK

A. Examine Contract Documents for requirements that affect work of this Section. Other Specification Sections that directly relate to work of this Section include, but are not limited to:

1. Section 033001, CAST-IN-PLACE CONCRETE - SITEWORK
2. Section 079200, EXTERIOR SEALANTS

1.03 REFERENCES

A. Comply with applicable requirements of the following standards. Where these standards conflict with other specified requirements, the most restrictive requirements shall govern.

1. American Concrete Institute (ACI):

   301 Specifications for Structural Concrete for Buildings

   305R Hot Weather Concreting

   306R Cold Weather Concreting

   325.9R Guide for Construction of Concrete Pavements and Concrete Bases.

2. American Society for Testing and Materials (ASTM):

   A 185 Welded Steel Wire Fabric for Concrete Reinforcement

   A 615 Deformed and Plain Billet - Steel Bars for Concrete Reinforcement

   C 33 Concrete Aggregates

   C 94 Ready-Mixed Concrete

   C 143 Slump of Portland Cement Concrete

   C 150 Portland Cement

   C 171 Sheet Materials for Curing Concrete

   C 231 Air Content of Freshly Mixed Concrete by the Pressure Method

   C 260 Air Entraining Admixtures for Concrete

   C 309 Liquid Membrane-Forming Compounds for Curing Concrete

C 494 Chemical Admixtures for Concrete

C 920 Elastomeric Joint Sealants

C 962 Guide for Use of Elastomeric Joint Sealants

D 226 Asphalt-Saturated Organic Roofing Felt for Use in Membrane Waterproofing and Built-Up Roofing

D 1557 Moisture - Density Relations of Soils and Soil Aggregate Mixtures Using 10 lb. (4.54-kg) Rammer and 18-in. (457 mm) Drop

D 1752 Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction

3. Americans with Disabilities Act (ADA):

   Appendix to Part 1191 Accessibility Guidelines for Buildings and Facilities

4. Corps of Engineers (COE):

   CRD-C 621 Specification for Nonshrink Grout: Hardened State Volume Change

5. Federal Specifications (Fed Spec.):

   TT-S-00227 Sealing Compound: Elastomeric Type, Multi-Component (For Calking, Sealing, and Glazing in Buildings and other Structures)

6. New York Department of Transportation (NYDOT):

   Specifications Standard Specifications for Road and Bridge

7. Construction

1.04 SUBMITTALS

A. Description of Methods and Sequence of Placement.

B. Submit manufacturer's product data for the following:

   1. Form release agent.
   2. Preformed joint filler.
   3. Joint sealants.

C. Submit samples of the following:

   1. Preformed joint filler.
   2. Color chart for selection of joint sealant color.

D. Verification Samples: Submit representative samples of the following materials for approval prior to construction of sample panels. Show full color ranges and finish variations expected. Provide samples having minimum size of 2 ft. X 3 ft.

E. Design Mixtures: For each concrete pavement mixture. Include alternate mixture designs when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

F. Material Certificates: Signed by manufacturers certifying that each of the following materials complies with requirements:

   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.

3. Admixtures.
4. Curing compounds.
5. Bonding agent or epoxy adhesive.

G. Minutes of preinstallation conference.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

B. ACI Publications: Unless otherwise specified, work and materials for construction of the Portland cement concrete paving shall conform to ACI 325.9R.

C. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1.

1. Before submitting design mixtures, review concrete pavement mixture design and examine procedures for ensuring quality of concrete materials and concrete pavement construction practices. Require representatives, including the following, of each entity directly concerned with concrete pavement, to attend conference:
   a. Contractor's superintendent.
   b. Independent testing agency responsible for concrete design mixtures.
   c. Ready-mix concrete producer.

E. Work, materials, and color of paving shall conform to applicable sections of Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.

F. Paving work, base course etc., shall be done only after excavation and construction work which might injure them have been completed. Damage caused during construction shall be repaired before acceptance.

G. Existing paving areas shall, if damaged or removed during course of this project, be repaired or replaced under this section of the specification. Workmanship and materials for such repair and replacement, except as otherwise noted, shall match as closely as possible those employed in existing work.

H. Pavement, base, or subbase shall not be placed on a muddy or frozen subgrade.

1.06 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

1.07 PRECONSTRUCTION MOCK-UP PANELS

A. General

1. Schedule mock-up casting for acceptance 30 days prior to casting of concrete surfaces represented by the mockups.
2. Locate mock-up panels in non-public areas accepted by the Director's Representative.
3. Continue to cast mock-ups until acceptable mock-ups area produced. Accepted mock-ups shall be the standard for color, texture, and workmanship for the work.
4. Mock-up sequence of forming, placing, form removal, curing, and finishing shall be reviewed and accepted by the Director's Representative.
5. Mock-up formwork shall be inspected and accepted by the Director's Representative before placing of concrete.
6. Use the same concrete mixes and placement procedures, accepted in mock-ups, in the final work, unless otherwise directed by the Director's Representative.
7. Protect accepted mock-ups from damage until completion and acceptance of the work represented by the mock-up.
8. Remove mock-up panels from site at completion of project, as directed by the Director's Representative.

B. Construct mock-up panels or areas as indicated to demonstrate the ability to cast concrete for concrete paving to achieve shape, color, jointing and textured finish required. Mock-ups shall include or meet the following requirements:

1. Provide mock-up panel 5 ft. x 5 ft. size, full depth.
2. Provide mock-ups simulating actual design and execution conditions for concrete mix materials, reinforcement, formwork, placing sequence, form removal, curing, finishing, and methods and materials of stain removal and correction of defective work.
3. On mock-ups where directed by the Director's Representative, provide minimum of three variation of mix color to be used in the repair of defective work, in order to determine acceptable color and texture match.
4. Demonstrate in the construction of the mock-up formwork the sealer material, form release agent, and curing materials and methods to be used. Include control joints and expansion joints with joint sealer.

C. Source of Materials. Utilize the same source, stock, or brand of concrete materials for each lass or mix of concrete which is to be exposed. Do not interchange materials or mixes until an additional mock-up shows that uniformity in finish texture and color, as compared to original mock-up will be maintained. If necessary, obtain and stockpile materials in sufficient quantity to ensure continuity and uniformity.

1.08 TESTING AND INSPECTION

A. Contractor shall provide a minimum of four (4) test results indicating compliance with minimum compressive strength requirements of fully cured concrete pavement.

B. The Owner reserves the right to inspect and test paving and associated work.

PART 2 PRODUCTS

2.01 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

B. Use flexible or curved forms for curves of a radius 100 feet (30.5 m) or less.

C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.02 STEEL REINFORCEMENT

A. Welded wire fabric reinforcement shall conform to the following applicable requirements. Fabric reinforcement shall be furnished in flat sheets. Fabric reinforcement in rolls will not be permitted.

1. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.
2. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.
3. Epoxy-Coated Welded Wire Fabric: ASTM A 884/A 884M, Class A, plain steel.

B. Joint Dowel Bars: Plain steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

C. Epoxy-Coated Joint Dowel Bars: ASTM A 775/A 775M; with ASTM A 615/A 615M, Grade 60 (Grade 420), plain steel bars.

D. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2.03 PORTLAND CEMENT CONCRETE

A. Portland cement concrete for pavements and slabs shall be air-entrained type with a maximum water-cement ratio of 0.50 conforming to ACI 325.9R. Minimum compressive strengths at 28 days shall be 4,000 psi.

1. Concrete shall be air-entrained type, conforming to ASTM C 94. Air content by volume shall be 6% + 1%, and shall be tested in accordance with ASTM C 231.
2. Concrete slump shall be no less than 2 in. nor greater than 4 in., determined in accordance with ASTM C 143.
3. Cement shall be Portland cement, conforming to ASTM C 150, Type I or II. Only one color of cement, all of the same manufacturer, shall be used for the work. Type III cement shall be used only with the prior approval of the Director’s Representative.
4. Fine and coarse aggregates shall conform to ASTM C 33.
5. Concrete shall contain a water reducing agent to minimize cement and water content of the concrete mix at the specified slump. Water reducing agent shall conform to ASTM C 494.
6. No calcium chloride or admixtures containing calcium chloride shall be added to the concrete. No admixtures other than those specified shall be used in the concrete without the specific written permission of the Director’s Representative in each case.

2.04 CHEMICAL ADMIXTURES

A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.

2.05 CURING MATERIALS

A. Curing shall be by moist curing or by use of curing compound.

B. Curing paper shall be a nonstaining, fiber reinforced laminated kraft bituminous product conforming to ASTM C 171. Four mil polyethylene sheeting may be substituted for curing paper.

C. Water: Potable.

D. Curing compound shall be a clear compound conforming to ASTM C 309, Type 1 or white pigmented compound conforming to ASTM C 309 Type 2, Class B.

2.06 EXPANSION JOINTS

A. Unless otherwise indicated on the Drawings, expansion joints shall be located 30 ft. o.c., maximum.

B. Expansion joint filler shall be preformed, nonbituminous type joint filler conforming to ASTM D 1752, Type II, similar to Sealtight Cork Expansion Joint Filler, manufactured by W.R. Meadows, Inc., Elgin, IL 60120, or approved equal.

1. Premolded filler shall be one piece for the full depth and width of the joint leaving a sealant recess as indicated.
2. Use of multiple pieces of lesser dimensions to make up required depth and width of joint will not be permitted.
3. Except as otherwise noted on the Drawings, joint filler shall be 3/8 in. thick.

C. Dowels shall be furnished under this Section, and shall be Type 304 stainless steel.

2.07 SEALANT

A. Sealant for sealing of expansion joints in concrete walks shall be a two component polyurethane based sealant conforming to Section 079200, EXTERIOR SEALANTS.

2.08 CONTROL JOINTS

A. Control joints indicated on the Drawings to be sawn, shall be made by saw cutting concrete slab after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw blade shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

B. Unless otherwise indicated on the Drawings, control joints shall be located 10 ft. o.c. maximum.

2.09 CONSTRUCTION JOINTS

A. Transverse construction joints shall be placed whenever placing of concrete is suspended for more than 30 minutes.

1. Butt joint with dowels or thickened edge joint shall be used if construction joints occurs at location of control joint.
2. Keyed joints with tiebars shall be used if the joint occurs at any other location.

2.10 GROUT

A. Grout shall be mixed in the proportions of one part Portland cement to two parts sand, by volume. Only sufficient water shall be used to enable grout to barely hold its shape when squeezed into a ball in the hand. Sand for grout shall be "Fine Aggregate", conforming to ASTM C 33.

B. Nonshrink grout shall be pre-mixed non-shrinking, high strength grout. Compressive strength in 28 days shall be 5,000 psi minimum, but in no case less than the specified strength of the adjacent concrete. Manufacturer shall provide evidence that the material meets the requirements of the COE CRD-C 621 (558). Grout permanently exposed to view shall be nonoxidizing; metallic grout may be used in other locations.

1. Nonshrink grout shall be one of the following, or approved equal:

   Manufacturer Product

   Gifford-Hill Co. Supreme

   Master Builders Co. Embeco

   U.S. Grout Corporation Five Star Grout

2.11 BOND BREAKER

A. Bond breaker shall be asphalt felt conforming to ASTM D 226, Type I or 6 mil polyethylene sheeting.

PART 3 EXECUTION

3.01 GRADING

A. Areas to be paved will be compacted and brought approximately to subgrade elevation under work performed by others under separate contract with the Owner before work of this section is performed. Final fine grading, filling, and compaction of subgrade to receive paving to form a firm, uniform, accurate, and unyielding subgrade at required elevations and to required lines, shall be done under this Section.

B. Existing subgrade material which will not readily compact shall be removed and replaced with satisfactory material.

C. Subgrade of areas to be paved shall be recompacted to bring top 8 in. of material immediately below concrete pavement to a compaction of at least 95% of maximum density, as determined by ASTM D 1557, Method D. Subgrade compaction shall extend for a distance of at least 1 ft. beyond pavement edge.

1. Surface irregularities which exceed 1/2 in. as measured by means of a 10 ft. long straightedge, shall be replaced and properly recompacted.

D. Excavation required in pavement subgrade shall be completed before fine grading and final compaction of subgrade are performed. Where excavation must be performed in completed subgrade subsequent backfill and compaction shall be performed as directed by the Director’s Representative as specified above.

E. Areas being graded or compacted shall be kept shaped and drained during construction. Ruts greater than or equal to 1 in. deep in subgrade, shall be graded out, reshaped, and recompacted before placing pavement.

F. Materials shall not be stored or stockpiled on subgrade.

G. Disposal of debris and other material excavated and/or stripped under this section, and material unsuitable for or in excess of requirements for completing work of this Section shall conform to the following:

1. Material shall be legally disposed of off-site.

H. Prepared subgrade will be inspected and tested by an independent testing agency, provided and paid for by the Contractor, prior to installation of paving. Disturbance to subgrade caused by inspection procedures shall be repaired under this Section of the specification.

1. Contractor shall submit a minimum of six (6) Proctor compaction test results indicating conformance to compaction density requirements specified herein.

I. Subgrade shall be kept clean and uncontaminated.

J. Portions of subgrade which become contaminated, softened, or dislodged by passing of traffic, or otherwise injured, shall be cleaned, replaced, or otherwise repaired to conform to the requirements of this specification before proceeding with paving operations.

3.02 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.03 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Before being placed in position, reinforcing for reinforced concrete shall be thoroughly cleaned of loose mill and rust scale, dirt, ice, and other foreign material which may reduce the bond between the concrete and reinforcing. Where there is delay in placing concrete after reinforcement is in place, bars shall be reinspected and cleaned when necessary.

C. Unless otherwise indicated on the Drawings, reinforcing shall extend within 2 in. of formwork and expansion joints. Reinforcing shall continue through control joints. Adjacent sheets of fabric reinforcing shall lap 6 in.

D. After forms have been coated with form release agent, but before concrete is placed, reinforcing steel anchors shall be securely wired in the exact position called for, and shall be maintained in that position until concrete is placed and compacted. Chair bars and supports shall be provided in a number and arrangement satisfactory to the Director’s Representative.

E. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.04 PORTLAND CEMENT CONCRETE PAVING

A. Paving mix, equipment, methods of mixing and placing, and precautions to be observed as to weather, condition of base etc., shall meet the requirements of ACI 325.9R. Pavement shall be constructed in accordance with the Drawings.

B. The Director's Representative shall be notified of concrete placement sufficiently in advance of start of operation to allow his representative to complete preliminary inspection of the work, including subgrade, forms, and reinforcing steel, if used.

C. Normal concrete placement procedures shall be followed. Concrete shall arrive at the jobsite so that no additional water will be required to produce the desired slump. When conditions develop that required addition of water to produce the desired slump, permission of the Director's Representative must be obtained. The concrete shall be transported from the mixer to its place of deposit by a method that will prevent segregation or loss of material.

D. Work shall not be performed during rainy weather or when temperature is less than 40° F. (4.4° C).

E. Adjacent work, etc., shall be protected from stain and damage during entire operation. Damaged and stained areas shall be replaced or repaired to equal their original conditions.

F. Existing concrete, earth, and other water-permeable material against which new concrete is to be placed shall thoroughly damp when concrete is placed. There shall be no free water on surface.

G. Concrete which has set or partially set before placing shall not be employed. Retempering of concrete will not be permitted.

H. Concrete shall be thoroughly spaded and tamped to secure a solid and homogeneous mass, thoroughly worked around reinforcement and into corners of forms.

I. When joining fresh concrete to concrete which has attained full set, latter shall be cleaned of foreign matter, and mortar scum and laitance shall be removed by chipping and washing. Clean, roughened base surface shall be saturated with water, but shall have no free water on surface. A coat of 1:1 cement-sand grout, approximately 1/8 in. thick, shall be well scrubbed into thoroughly dampened concrete base. New concrete shall be placed immediately, before grout has dried or set.

3.05 FINISHING

A. Concrete flatwork surfaces shall be screeded off, bullfloated, power or hand floated, troweled and finished true to line and grade, and free of hollows and bumps. Surface shall be dense, smooth, and at exact level and slope required.

1. Finished concrete surface for below grade bases and slabs shall be woodfloated to a slightly rough surface in accordance with Section 033001, CAST-IN-PLACE CONCRETE - SITEWORK.
2. Finished concrete surface for exposed concrete walks and pads shall be wood-floated and steel troweled to a smooth surface.

B. Immediately following finishing operations, arises at edges and both sides of expansion joints shall be rounded to a 1/4 in. radius. Control joints to be sawn shall be scored into slab surface with early entry type concrete power saw.

C. Where finishing is performed before end of curing period, concrete shall not be permitted to dry out, and shall be kept continuously moist from time of placing until end of curing period, or until curing membrane is applied.

3.06 CURING

A. It is essential that concrete be kept continuously damp from time of placement until end of specified curing period. It is equally essential that water not be added to surface during floating and troweling operations, and not earlier than 24 hours after concrete placement. Between finishing operations surface shall be protected from rapid drying by a covering of waterproofing paper. Surface shall be damp when the covering is placed over it, and shall be kept damp by means of a fog spray of water, applied as often as necessary to prevent drying, but not sooner than 24 hours after placing concrete. None of the water so applied shall be troweled or floated into surface.

B. Concrete surfaces shall be cured by completely covering with curing paper or application of a curing compound.

1. Concrete cured using waterproof paper shall be completely covered with paper with seams lapped and sealed with tape. Concrete surface shall not be allowed to become moistened between 24 and 36 hours after placing concrete. During curing period surface shall be checked frequently, and sprayed with water as often as necessary to prevent drying, but not earlier than 24 hours after placing concrete.
2. If concrete is cured with a curing compound, compound shall be applied at a rate of 200 sq. ft. per gallon, in two applications perpendicular to each other.
3. Curing period shall be seven days minimum.

3.07 CONSTRUCTION JOINTS

A. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

1. Continue steel reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
2. Provide tie bars at sides of pavement strips where indicated.
3. Butt Joints: Use epoxy bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

3.08 EXPANSION JOINTS

A. Expansion joints (isolation joints) shall be 3/8 in. wide and unless otherwise indicated on the Drawings, shall be located 30 ft. o.c. and at places where pavement meets other structures. Expansion joint shall be formed in the concrete to required width with preformed joint filler in place. Joint filler shall extend the full width and depth of the slab. Joint filler shall extend the full length of the expansion joint.

1. Depth of joint filler shall be as required to form a 1-1/4 in. deep sealant and backer rod recess below finished concrete surface.

B. Unless otherwise indicated, expansion joints of slab-on-grade shall be doweled. Dowel shall be centered over the joint prior to concrete placement. The end of the dowel at the side of joint which will be poured second shall be greased immediately before concrete placement.

3.09 SEALING OF JOINTS

A. Where indicated on the Drawings, expansion joints and construction joints shall be sealed with joint sealant in accordance with the precautions specified in the Appendix of ASTM C 962, and as specified in Section 079200, EXTERIOR SEALANTS.

3.10 CONTROL JOINTS

A. Control joints indicated shall be sawn by using an early entry type, diamond blade concrete power saw. Joint shall be made after concrete is finished and when the surface is stiff enough to support the weight of workmen without damage to the slab. Saw shall cut into slab at least 1 in., but in no case less than 25% of slab depth.

3.11 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch (6 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/4 inch (6 mm).
4. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
5. Vertical Alignment of Dowels: 1/4 inch (6 mm).
6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
7. Joint Spacing: 3 inches (75 mm).
8. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
9. Joint Width: Plus 1/8 inch (3 mm), no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least 1 composite sample for each 100 cu. yd. or fraction thereof of each concrete mix placed each day.
    a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mix. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C 231, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mix.
4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test 1 specimen at 7 days and 2
7. specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from 2 specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mix will be satisfactory if average of any 3 consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

D. Test results shall be reported in writing to Director's Representative, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Director's Representative but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Director's Representative.

G. Remove and replace concrete pavement where test results indicate that it does not comply with specified requirements.

END OF SECTION

SECTION 323113

ENCLOSURE FENCE AND GATES – ALTERNATE 3

PART 1 GENERAL

1.01 GENERAL PROVISIONS

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

1.02 WORK INCLUDED

A. Work in this section shall include but is not limited to the following:

1. Metal Post and Woven Wire Mesh Fence for Fox Enclosure.

1.03 RELATED WORK

A. Section 099000, Painting.

B. Section 033001, Cast-In-Place Concrete.

1.04 REFERENCES

A. Comply with ASTM A 53 for requirements of Schedule 40 piping.

1.05 DEFINITIONS

A. Height of Fence: Distance measured from the top of concrete footing to the top of fabric. Fences with buried fabric measured from finished grade to the top of fabric.

1.06 SUBMITTALS

A. Shop Drawings: Complete detailed drawings for fence layout and gate designs. Include Details of Electric Fencing Assembly. Drawings should include overall plan with post locations and sizes. Include separate schedule with all materials required and technical data such as size, weight, and finish. Director’s Representative shall approve drawings prior to construction.

B. Product Data: Manufacturer’s catalog cuts, specifications, and installation instructions for each item specified.

C. Samples:

1. Woven Wire Mesh: Minimum one square foot.
2. Fence and Gate Posts: Two each, one foot long, if requested.

D. Quality Control Submittals:

1. Certificates: Affidavit required under Quality Assurance Article.

1.07 QUALITY ASSURANCE

A. Provide fence and related gates as a complete compatible system including necessary erection accessories, fittings, and fastenings.

B. Posts and rails shall be continuous without splices.

PART 2 PRODUCTS

2.01 STEEL FRAMEWORK (FOR FENCES 6'1" – 10'-0" HIGH)

A. End Posts, Corner Posts and Pull Posts:

1. Pipe: 2.875 inches OD, 5.79 pounds per linear foot (Schedule 40).
2. Square Tubing: 2.50 inches OD, 5.70 pounds per linear foot.
3. Class B Steel Tubing: 2.875 inches OD, 4.64 pounds per linear foot.

B. Line Posts:

1. Pipe: 2.375 inches OD, 3.65 pounds per linear foot (Schedule 40).
2. Class B Steel Tubing: 2.375 inches OD, 3.11 pounds per linear foot.
3. H-section: 2.25 inches by 1.95 inches by 0.143 inches, 4.10 pounds per linear foot.

2.02 WOVEN WIRE MESH

A. Handwoven Stainless Steel Mesh, Black Oxide Finish, by Nettem' by A thru Z, 8620 E. Old Vail Rd, Suite 100, Tucson, AZ, 85747, (520) 434-8281.

1. Opening Size: 1"x1", see drawings for location.
2. Opening Size: 1½"x1½", see drawings for location.
3. Opening Size: 3"x3", see drawings for location.

B. One-piece widths for fence heights up to 8'-0".

2.03 STAINLESS STEEL CABLE

2.04 SWING GATE POSTS

A. Single width of gate 4'-0" to 6'-0" wide or over 8'-0" high:

1. Pipe: 4 inches OD, 9.11 pounds per linear foot (Schedule 40).
2. Class B Steel Tubing: 4 inches OD, 6.56 pounds per linear foot.
3. Square Tubing: 3 inches OD, 9.10 pounds per linear foot.
4. Roll Formed C-Section: ASTM A 570 Grade 45, 3.5 inches by 3.5 inches by 0.128 inch thick, with minimum bending strength of 486 pounds under a 6 foot cantilever load.

2.05 SWING GATE FRAMES

A. Height: 4'-0" - 6'-0", or leaf width exceeding 8'-0":

1. Pipe: 1.90 inches OD, 2.72 pounds per linear foot (Schedule 40).
2. Square Tubing: 2 inches OD, 2.60 pounds per linear foot.
3. Class B Steel Tubing: 1.90 inches OD, 2.28 pounds per linear foot.

B. Assemble gate frames by welding or with special steel fittings and rivets for rigid connections. Install mid-height horizontal rails on gates over 10 feet high. When width of gate leaf exceeds 10 feet, install mid-distance vertical bracing of the same size and weight as frame members.

C. When either horizontal or vertical bracing is not required, provide truss rods as cross bracing to prevent sag or twist.

2.06 SWING GATE HARDWARE

A. Hinges, Type “B” and “C” Gates: Style M 61, Heavy Industrial Offset Ball and Socket Hinge by Anchor Die Cast, Inc., P.O. Box 1197, Harrison, AK 72601, (501) 741-6193.

B. Locks:

1. Type “C” Gate: Drop bar type complete with flush plate set in concrete. For double gates provide full height drop bar and keeper. Padlock eye shall be an integral part of latch construction.

2.07 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Rails and Post Braces:

1. Pipe: 1.660 inches OD, 2.27 pounds per linear foot (Schedule 40).
2. Class B Steel Tubing: 1.660 inches OD, 1.84 pounds per linear foot.
3. Roll formed C-Section: 1.625 inches by 1.25 inches by 0.0747 inch thick with minimum bending strength of 192 pounds on a 10-foot span.

B. Fittings and Post Tops: Steel, wrought iron, or malleable iron.

1. Fasteners: Tamper-resistant cadmium plated steel screws.

C. Stretcher Bars: One piece equal to full height of fabric, minimum cross- section 3/16 inch by 3/4 inch.

D. Metal Bands (for securing stretcher bars): Steel, wrought iron, or malleable iron.

E. Wire Ties: Conform to American Steel Wire gauges.

1. For tying fabric to line posts, rails and braces: 9 gauge (.1483 inch) steel wire.

F. Truss Rods: 3/8 inch diameter.

G. Concrete: Portland Cement concrete having a minimum compressive strength of 4000 psi at 28 days.

H. Spiral Paper Tubes:

1. Sonotube by Sonoco Products Co., North Second St., Hartsville, SC 29550, (800) 377-2692.
2. Sleek/tubes by Jefferson Smurfit Corp., P.O. Box 66820, St. Louis, Mo 63166, (314) 746-1100.

I. Cold Galvanizing Compound: Single component compound giving 93 percent pure zinc in the dried film, and meeting the requirements of DOD-P-21035A (NAVY).

J. Wedge Anchors: 1/2 inch stainless steel, Style TS-12-234SS by Unifast Industries Inc., 45 Gilpin Ave., Hauppauge, NY 11788, (516) 348-0290.

K. Shrink-Resistant Grout (Ferrous): Factory-packaged, non-catalyzed, ferrous aggregate mortar grouting compound selected from the following:

1. Embeco 636 by Master Builders, 23700 Chagrin Blvd., Cleveland, OH 44122, (800) 227-3350.
2. Ferrolith G-NC by Sonneborn, Chemrex, Inc., 57-46 Flushing Ave., Maspeth, NY 11378, (800) 433-9517.
3. Ferro-Grout by L&M Construction Chemicals, 14851 Calhoun Rd., Omaha, NB 68152, (800) 362-3331.
4. Vibra-Foil by A.C. Horn, Inc., Tamm Industries, 7405 Production Dr., Mentor, OH 44060, (800) 862-2667.

2.08 ELECTRIC FENCE

A. Components shall include but are not limited to the following:

1. Electrical fencing wire, min. 12 gauge for lead and ground wires.
2. Fence Controller System, grounding rods, and fuses.
3. Extension Arms: Pressed steel, wrought iron, or malleable iron, complete with provision for anchorage to posts and attaching 1 row of electrical wire to each arm. Single 45 degree arm; one for each post.
4. Offset Insulators.

2.09 FINISHES

A. Steel Framework: Galvanized, color section by owner.

B. Fence and Gate Hardware, Miscellaneous Materials, Accessories: Galvanized, color selection by owner.

PART 3 EXECUTION

3.01 PREPARATION

A. Clear and grub along fence line as required to eliminate growth interfering with alignment. Remove debris from State property.

B. Do not begin installation of fence in areas to be cut until finished grading has been completed.

1. Follow all Woven Wire Fence manufacturer recommendations for Installation methods. Post shall be set equidistant in the fence line with a maximum of 10 feet on center.
2. Setting Posts in Earth: Drill holes for post footings. If existing grade at the time of installation is below finished grade, provide spiral paper tubes to contain concrete to finish grade elevation. Set posts in center of hole and fill hole with concrete. Plumb and align posts. Vibrate or tamp concrete for consolidation. Finish concrete in a dome

shape above finish grade elevation to shed water. Do not attach fabric to posts until concrete has cured a minimum of 7 days.

3. Setting Posts in Rock: Drill holes into solid rock one inch wider than post diameter, 3 feet deep for end, pull, corner, and gate posts, and 2 feet deep for line posts. Set posts into holes and fill annular space with shrink-resistant grout.
4. Install top cable continuously through post tops or extension arms per woven wire fence manufacturer recommendations. Install expansion couplings as recommended by fencing manufacturers.
5. Install intermediate rail in one piece between posts and flush with post on fabric side using special offset fittings where necessary.
6. Brace corner posts, pull posts, end posts, and gate posts to adjacent line posts with horizontal rails per manufacturer recommendations.
7. Diagonally brace corner posts, pull posts, end posts, and gate posts adjacent line posts with truss rods and turnbuckles.
8. Paint all Posts and Hardware per owner color selection. See Painting specifications under Section 099000.
9. Attach fabric to security side of fence. Maintain a 2 inch clearance above finished grade except when indicated otherwise. Pull fabric tight so that the maximum deflection of fabric is 2 inches when a 30 pound pull is exerted perpendicular to the center of a panel. Maintain tension by securing stretcher bars to posts with metal bands spaced 15 inches oc. Fasten fabric to steel framework with wire ties spaced 12 inches oc for line posts and 24 inches oc for rails and braces. Bend back wire ends to prevent injury. Tighten stretcher bar bands, wire ties, and other fasteners securely.
    a. Where fabric is indicated to be buried, the buried portion of fabric shall be separate from the main fence fabric. Overlap main fabric and buried fabric a minimum of 6 inches at the bottom rail, and secure with wire ties spaced 12 inches oc.
    b. Eliminate all rattles from stretcher bar bands, truss rods, rail and post clamps, and other hardware.
10. Position bolts for securing metal bands and hardware so nuts are located opposite the fabric side of fence. Tighten nuts and cut off excess threads so no more than 1/8 inch is exposed. Peen ends to prevent loosening or removal of nuts.
    a. Secure post tops and extension arms with tamper-resistant screws.
11. Install gates plumb and level and adjust for full opening without interference. Install ground-set items in concrete for anchorage, as recommended by fence manufacturer. Adjust hardware for smooth operation and lubricate where necessary.
12. Installing Electric Fencing System: Install the electrical fence in a manner that will permit satisfactory operation of a fence system. Conform to the following:
    a. When using metal fence posts, make sure fence wires are insulated and cannot energize the wire mesh or posts.
    b. Install three ground rods into the earth 6 ft. deep, spaced 10 ft. apart. If possible, install ground rods in areas of constant moisture.
    c. Install first copper ground rod within 20 ft. of the fence controller. Use a ground rod clamp to attach the insulated ground wire to the ground rod

(clamp must bite into rod and ground wire). The ground wire should be 10 to 14 gauge wire and insulated from 600V to 20,000 volts.

d. Do not install ground rods within 50 ft. of a utility ground rod, buried telephone line, or buried water-line.

e. Perform proper testing to ensure satisfactory operation at time of completion.

13. Restore disturbed ground areas to original condition. Topsoil to match adjacent areas.

END OF SECTION

SECTION 329100

TOPSOIL

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 312000

1.03 SUBMITTALS

A. Samples:

1. Topsoil for Testing: In the presence of the Director's Representative, take a 5-lb. sample from each 1000 cu yds of topsoil to be used on the project. Complete a Topsoil Sample Information Form for each sample. Ship samples and forms (original and 2 copies) to the address indicated in Section 01300.

1.04 QUALITY ASSURANCE

A. Topsoil used on this project shall be tested, and approved before placement.

B. Secure approval before stripping topsoil from a borrow area or delivering topsoil to the project site.

PART 2 PRODUCTS

2.01 TOPSOIL

A. Provide topsoil conforming to the following:

1. Original loam topsoil, well drained homogeneous texture and of uniform grade, without the admixture of subsoil material and entirely free of dense material, hardpan, sod, or any other objectionable foreign material.

2. Containing not less than 4 percent nor more than 20 percent organic matter in that portion of a sample passing a 1/4 inch sieve when determined by the wet combustion method on a sample dried at 105 degrees C.

3. Containing a pH value within the range of 4.5 to 7 on that portion of the sample which passes a 1/4 inch sieve.

4. Containing the following gradations:

SIEVE DESIGNATION	PERCENT PASSING
1 INCH	100
1/4 INCH	97 - 100
No. 200	20 - 65 (OF THE 1/4 INCH SIEVE)

PART 3 EXECUTION

3.01 PREPARATION

A. Grub out and remove all vegetation in the area of the approved topsoil source.

3.02 SPREADING TOPSOIL

A. Perform topsoil spreading operations only during dry weather.

B. To insure a proper bond with the topsoil, harrow or otherwise loosen the subgrade to a depth of 3 inches before spreading topsoil.

C. Spread topsoil directly upon prepared subgrade to a minimum depth measuring 4 inches after natural settlement in areas to be seeded. In sodded areas the thickness of the topsoil after natural settlement plus the sod shall equal 4 inches. Smooth out unsightly variations, bumps, ridges, and depressions which will hold water. Remove stones, litter, or other objectionable material. Finished surfaces shall conform to the contour lines and elevations indicated on the drawings or fixed by the Director's Representative.

D. Topsoil shall not be spread in or over areas of exposed bedrock that exceeds one foot vertical to three-foot horizontal pitch. Topsoil shall be stabilized in all other sloped conditions where erosion and runoff may occur.

END OF SECTION

SECTION 330110

DISINFECTION OF POTABLE WATER LINES

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Conform to provisions of AWWA C-651 for water line disinfection. Do not use Tablet Method therein.

B. Conform to provisions of AWWA C-652 for water tank disinfection.

C. Comply with all requirements of the New York State Department of Health for disinfection of potable water lines, valves, hydrants, storage tanks, and appurtenances.

PART 2 PRODUCTS

2.01 DISINFECTANT

A. Chlorine Gas meeting AWWA B301.

B. Hypochlorites meeting AWWA B300.

2.02 TEST KITS

A. High range test kit for chlorine residual (0-200 mg/1) Hach Chemical Co. Model CN-21P.

B. DPD chlorine residual test kit (0-3.5 mg/1) Hach Chemical Co. Model CN-66.

C. Test kits to remain property of the Contractor.

PART 3 EXECUTION

3.01 DISINFECTION - WATER MAINS

A. Flush mains with clear water at a minimum rate of 2.5 fps prior to disinfection. See Table 1.

TABLE 1 - WATER MAIN FLUSHING DATA		
PIPE DIAMETER (INCHES)	**FLUSHING RATE GPM @ 2.5 fps**	**HYDRANT OPENINGS @ 40 psi**
2	25	one - 2-1/2
4	100	one - 2-1/2
6	220	one - 2-1/2
8	390	one - 2-1/2
10	610	one - 2-1/2
12	880	one - 2-1/2
14	1200	two - 2-1/2
16	1570	two - 2-1/2
18	1985	two - 2-1/2
24	3525	one - 4-1/2 and one - 2-1/2

B. Chlorine Gas: Apply with a solution-feed chlorinator in combination with a booster pump for injecting the chlorine gas-water mixture into the main. Do not use direct feed chlorinators.

C. Hypochlorites: Apply solutions to water mains with a gasoline or electrically powered chemical feed pump designed for feeding chlorine solutions.

D. Application (Continuous Feed Method).
   1. Connect chlorinator or force pump to water main upstream from point of repair or replacement, or new lines.
   2. Proportion application rate of chlorine solution to obtain a minimum concentration of 50 mg/1 of available chlorine. Use high range test kit to determine concentration. See Table 2.

TABLE 2 - QUANTITY OF DISINFECTANT REQUIRED FOR 50 mg/l OF AVAILABLE CHLORINE PER 100 FT. OF PIPE							
PIPE DIAMETER (INCHES)	**POUNDS**		**OUNCES**			**QUARTS**	
	Cl GAS	**SOLUTION HYPOCHLORITE**					
		70%	**70%**	**14.7%**	**5.25%**	**14.7%**	**5.25%**
2	0.1	0.1	0.2	0.8	2.1	0.1	0.1
4	0.1	0.1	0.6	3.0	8.3	0.1	0.3
6	0.1	0.1	1.4	6.7	18.7	0.2	0.6
8	0.1	0.2	2.5	11.9	33.2	0.4	1.1
10	0.2	0.3	3.9	18.5	51.9	0.6	1.6
12	0.3	0.4	5.6	26.7	74.7	0.9	2.4
14	0.4	0.5	7.6	36.3	102.0	1.2	3.2
16	0.5	0.7	10.1	47.5	133.0	1.5	4.2
18	0.6	0.8	12.6	60.0	168.0	1.9	5.3
24	1.0	1.4	22.4	107.0	298.0	3.4	9.4

3. In the absence of a meter, determine rate either by placing a pitot gage at discharge or by measuring the time to fill a container of known volume. See Table 3.

TABLE 3 - TIME FOR DISINFECTANT TO FLOW THROUGH 100 FT. OF PIPE - MINUTES

PIPE DIAMETER (INCHES)	@ 25 GPM	@ 100 GPM	@ 500 GPM
2	0.7	0.2	0.04
4	2.6	0.7	0.13
6	5.9	1.5	0.3
8	10.5	2.6	0.5
10	16.3	4.1	0.8
12	23.5	5.9	1.2
14	32.0	8.0	1.6
16	41.8	10.5	2.1
18	52.9	13.2	2.7
24	94.0	23.5	4.7

4. Continue to apply chlorine solution until it reaches discharge. Check for the presence of chlorine at discharge by adding an orthotolidine reagent. In the presence of chlorine the reagent will turn red.
5. Maintain chlorinated water in the main for a minimum of 24 hours. At the end of this period chlorine concentration shall be at least 25 mg/1. Use high range test kit to determine concentration.
6. Operate all valves and hydrants to insure their proper disinfection.
7. Prevent back flow of super chlorinated water into existing distribution system.

E. Final Flushing:
1. After a 24-hour retention period, flush main until maximum chlorine concentration is 1.0 mg/1. Use DPD chlorine residual test kit.
2. Discharge super chlorinated water in a manner that will not adversely affect plants and animals. Comply with applicable State regulations for waste discharge.

F. Bacteriological Tests: Contact local health units for sampling criteria and procedures. Local health units may have more stringent criteria.
1. Test water main for bacteriological quality before putting pipe into service. A minimum of two successive sets of samples shall be taken at 24-hour intervals. Both sets of samples shall indicate bacteriological safe water before putting the facility in operation. Pay all expenses incurred for testing.
2. Tests shall be conducted by a laboratory approved by the New

York State Health Dept.

G. Give all test results to Director's Representative.
   1. Should test results prove any part of the system bacteriologically unsafe, repeat disinfection procedures until satisfactory results are obtained.

END OF SECTION

SECTION 330505

BURIED PIPING INSTALLATION

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment and incidentals as shown, specified and required to install and test all buried piping, fittings, and specials. The Work includes, but is not limited to, the following:
      a. All types and sizes of buried piping, except those specified under other Sections or other contracts.
      b. Piping beneath structures.
      c. Supports, restraints, and thrust blocks.
      d. Pipe encasements.
      e. Work on or affecting existing piping.
      f. Testing.
      g. Cleaning and disinfecting.
      h. Installation of all jointing and gasketing materials, specials, flexible couplings, mechanical couplings, harnessed and flanged adapters, sleeves, tie rods, and all other Work required to complete the buried piping installation.
      i. Incorporation of valves, meters and special items shown or specified into the piping systems as required and as specified in the appropriate Division 15 Sections.
      j. Unless otherwise specifically shown, specified, or included under other Sections, all buried piping Work required, beginning at the outside face of structures or structure foundations, and extending away from structure.

B. Coordination:
   1. Review installation procedures under other Sections and other contracts and coordinate with the Work that is related to this Section.
   2. Coordinate with Division 15 for buried piping materials.

C. Related Sections:
   1. Section 02200, Crushed Stone and Gravel.
   2. Section 02300, Earthwork.
   3. Section 02316, Rock Removal.
   4. Section 09900, Painting.
   5. Division 15, Sections on Piping, Valves and Appurtenances.

1.02 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Comply with requirements of UL, FM and other jurisdictional authorities, where applicable.
2. Refer to the General and Supplementary Conditions regarding permit requirements for this Project.

B. Reference Standards: Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
1. ANSI B31.1, Power Piping.
2. ASTM B 32, Specification for Solder Metal.
3. AWWA C901, ASTM D3035: for ½" to 3" HDPE Water Pipe
4. NSF Standard 14 and standard 61

1.03 SUBMITTALS

A. Shop Drawings: Submit for approval the following:
1. Full details of piping, specials, manholes, joints, harnessing and thrust blocks, and connections to existing piping, structures, equipment, and appurtenances.

B. Tests: Submit description of proposed testing methods, procedures, and apparatus. Prepare and submit report for each test.

C. Certificates: Submit certificates of compliance with referenced standards.

D. Record Drawings:
1. Submit record drawings prior to the time of Substantial Completion.

1.04 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to the site to ensure uninterrupted progress of the Work.

B. Handle all pipe, fittings, specials and accessories carefully with approved handling devices. Do not drop or roll material off trucks. Do not otherwise drop, roll or skid piping.

C. Store pipes and fittings on heavy wood blocking or platforms so they are not in contact with the ground.

D. Unload pipe, fittings, and specials opposite to or as close to the place where they are to be installed as is practical to avoid unnecessary handling. Keep pipe interiors completely free from dirt and foreign matter.

E. Inspect delivered pipe for cracked, gouged, chipped, dented, or other damaged material and immediately remove from site.

PART 2 PRODUCTS

2.01 MATERIALS

A. Required pipe materials are listed in the Piping Schedule. Refer to applicable Sections for material specifications.

B. General:
   1. Marking Piping:
      a. Clearly mark each piece of pipe or fitting with a designation conforming to those shown on the laying schedule.
      b. Cast or paint material, type and pressure designation on each piece of pipe or fitting 4 inches in diameter and larger.
      c. Pipe and fittings smaller than 4 inches in diameter shall be clearly marked by manufacturer as to material, type and rating.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:
   1. Install piping as shown, specified and as recommended by the manufacturer.
   2. If there is a conflict between manufacturer's recommendations and the Drawings or Specifications, request instructions from Director’s Representative before proceeding
   3. All trench excavations shall be inspected by Director’s Representative prior to laying pipe. Notify Director’s Representative in advance of excavating, bedding and pipe laying operations.
   4. Minimum cover over piping shall be 4 feet unless otherwise shown or approved by Director’s Representative.
   5. Earthwork required is specified in the applicable Sections of Division 2.
   6. Excavation in excess of that required or shown and which is not authorized by the Director’s Representative shall be replaced at Contractor’s expense with approved granular material. It shall be furnished, placed and compacted in accordance with the requirements of the applicable Section of Division 2.

B. Plugs:
   1. Temporarily plug installed pipe at the end of each day's work or other interruption to the installation of any pipe line. Plugging shall prevent the entry of animals, liquids or persons into the pipe or the entrance or insertion of deleterious materials.

2. Install standard plugs into all bells at dead ends, tees or crosses. Cap all spigot ends.
3. Fully secure and block all plugs and caps installed for pressure testing to withstand the specified test pressure.
4. Where plugging is required for phasing of the Work or for subsequent connection of piping, install watertight, permanent type plugs.

C. Bedding Pipe: Bed pipe as specified below and in accordance with the details shown.
1. Trench excavation and backfill and bedding materials shall conform to the requirements of Section 02300 or 02316, as applicable.
2. Where the existing bedding material is deemed unsuitable by Director's Representative, remove and replace it with approved granular materials. Payment for the additional excavation and crushed stone or gravel refill will be made at the unit prices bid in the Bid Form.
3. Where pipe is installed in rock excavation, provide a minimum of 8 inches of crushed stone or gravel under pipes.
4. Excavate trenches below the pipe bottom by an amount shown and specified. Remove all loose and unsuitable material from the trench bottom.
5. Carefully and thoroughly compact all pipe bedding with hand held pneumatic compactors.
6. Do not lay pipe until the Director's Representative approves the bedding condition. If a conflict exists obtain clarification from Director's Representative before proceeding.
7. No pipe shall be brought into position until the preceding length has been bedded and secured in its final position.

D. Laying Pipe:
1. Conform to manufacturer's instructions and requirements of the standards listed below, where applicable:
   a. Ductile Iron Pipe: AWWA C600, AWWA C105.
   b. ASCE Manual of Practice No. 37.
2. Install all pipe accurately to line and grade shown unless otherwise approved by Director's Representative. Remove and relay pipes that are not laid correctly.
3. Slope piping uniformly between elevations shown.
4. Ensure that ground water level in trench is at least 6 inches below bottom of pipe before laying piping. Do not lay pipe in water. Maintain dry trench conditions until jointing and backfilling are complete and protect and keep clean water pipe interiors, fittings and valves.
5. Start laying pipe at lowest point and proceed towards the higher elevations, unless otherwise approved by Director's Representative.
6. Place bell and spigot pipe so that bells face the direction of laying, unless otherwise approved by Director's

Representative.

7. Excavate around joints in bedding and lay pipe so that the barrel bears uniformly on the trench bottom.
8. Deflections at joints shall not exceed 75 percent of the amount allowed by the pipe manufacturer.
9. Carefully examine all pipe, fittings and specials for cracks, damage or other defects while suspended above the trench before installation. Immediately remove defective materials from site.
10. Inspect interior of all pipe and fittings and completely clean all dirt, gravel, sand, debris or other foreign material from pipe interior and joint recesses before it is moved into the trench. Bell and spigot mating surfaces shall be thoroughly wire brushed, and wiped clean and dry immediately before the pipe is laid.
11. Field cut pipe, where required, with a machine specially designed for cutting piping. Make cuts carefully, without damage to pipe or lining, and with a smooth end at right angles to the axis of pipe. Cut ends on push-on joint shall be tapered and sharp edges filed off smooth. Flame cutting will not be allowed.
12. Blocking under piping will not be permitted unless specifically approved by Director's Representative for special conditions. If permitted, conform to requirements of AWWA C600.
13. Touch up protective coatings in a satisfactory manner prior to backfilling.
14. Contractor shall notify Director's Representative in advance of backfilling operations.
15. On steep slopes, take measures acceptable to Director's Representative to prevent movement of the pipe during installation.
16. Thrust Restraint: During the installation of the pipe, thrust blocks, tied joints, or proprietary restrained joint systems shall be provided wherever required for thrust restraint. Thrust restraint shall conform to the applicable requirements of Article 3.2.

E. Jointing Pipe:

1. Ductile Iron Mechanical Joint Pipe:
    a. Wipe clean the socket, plain end and adjacent areas immediately before making joint. Make certain that cut ends are tapered and sharp edges are filed off smooth.
    b. Lubricate the plain ends and gasket with soapy water or an approved pipe lubricant, in accordance with AWWA C111, just prior to slipping the gasket onto the plain end of the joint assembly.
    c. Place the gland on the plain end with the lip extension toward the plain end, followed by the gasket with the narrow edge of the gasket toward the plain end.

d. Insert the pipe into the socket and press the gasket firmly and evenly into the gasket recess. Keep the joint straight during assembly.

e. Push gland toward socket and center it around pipe with the gland lip against the gasket.

f. Insert bolts and hand tighten nuts.

g. Make deflection after joint assembly, if required, but prior to tightening bolts. Alternately tighten bolts 180 degrees apart to seat the gasket evenly. The bolt torque shall be as follows:

Pipe Size (inches)	Bolt Size (inches)	Range of Torque (ft-lbs)
3	5/8	45-60
4-24	3/4	75-90
30-36	1	100-120
42-48	1-1/4	120-150

2. Proprietary Joints:

a. Pipe which utilizes proprietary joints such as Fastite, by American Cast Iron Pipe Company, Tyton by U.S. Pipe Incorporated, restrained joints described under Paragraph 3.02.D., or other such joints shall be installed in strict accordance with the manufacturer's instructions.

F. Backfilling:

1. Conform to the applicable requirements of Section 02300 or 02316.
2. Place backfill as construction progresses. Backfill by hand and use power tampers until pipe is covered by at least one foot of fill.

G. Connections to Valves and Hydrants:

1. Install valves and hydrants as shown.
2. Provide suitable adapters when valves or hydrants and piping have different joint types.
3. Provide thrust restraint at all hydrants and at valves at pipeline terminations.

H. Transitions from One Type of Pipe to Another:

1. Provide all necessary adapters, specials and connection pieces required when connecting different types and sizes of pipe or connecting pipe made by different manufacturers.

I. Closures:

1. Provide all closure pieces shown or required to complete the Work.

3.02 WORK AFFECTING EXISTING PIPING

A. Location of Existing Piping:
   1. Locations of existing piping shown should be considered approximate.
   2. Contractor shall determine the true location of existing piping to which connections are to be made, and location of other facilities which could be disturbed during earthwork operations, or which may be affected by Contractor's Work in any way.
   3. Conform to applicable requirements of Division 1 pertaining to cutting and patching, and connections to existing facilities.

B. Taking Existing Pipelines Out of Service:
   1. Do not take pipelines out of service unless specifically listed below, or approved by Director's Representative.
   2. Notify Director's Representative at least 7 days prior to taking pipeline out of service.

C. Work on Existing Pipelines:
   1. Cut or tap pipes as shown or required with machines specifically designed for this work.
   2. Install temporary plugs to prevent entry of mud, dirt, water and debris.
   3. Provide all necessary adapters, fittings, pipe and appurtenances required to complete the Work.

3.03 TESTING OF PIPING

A. General:
   1. Test all piping except as may be exempted in the Schedule.
   2. Notify Director's Representative and local authorities having jurisdiction at least 48 hours in advance of testing if their presence is required.
   3. Conduct all tests in the presence of the Director's Representative.
   4. Remove or protect any pipeline-mounted devices which may be damaged by the test pressure.
   5. Provide all apparatus and services required for testing, including but not limited to, the following:
      a. Test pumps, bypass pumps, hoses, calibrated gauges, meters, test containers, valves and fittings.
      b. Temporary bulkheads, bracing, blocking and thrust restraints.
   6. Provide air if an air test is required and power if pumping is required.
   7. Unless otherwise specified, State will provide fluid required for testing.
   8. Repair observed leaks and any pipeline failing to meet acceptance criteria. Retest after repair.

B. Test Schedule:
   1. Refer to the Piping Schedule for the type of test required and the required hydrostatic test pressure.
   2. Unless otherwise specified, the required hydrostatic test pressures are at the lowest elevation of the pipeline.
   3. For piping not listed in the Schedule:
      a. Hydrostatically test pipe that will be operating at a pressure greater than 5 psig.
      b. Use exfiltration testing or low-pressure air testing for all other piping.
   4. Hydrostatic Test Pressure:
      a. Use test pressures listed in the Schedule.
      b. If a test pressure is not listed in the Schedule, or if a hydrostatic test is required for piping not listed in the Schedule, the test pressure will be determined by the Director's Representative based on the maximum anticipated sustained operating pressure and the methods described in the AWWA Manual or Standard which applies to the piping system.

3.04 CLEANING AND DISINFECTION

A. Cleaning:
   1. Thoroughly clean all piping and flush in a manner approved by Director's Representative, prior to placing in service.
   2. Piping 24 inches in diameter and larger shall be inspected from inside and all debris, dirt and foreign matter removed.
   3. If piping which requires disinfection has not been kept clean during storage or installation, Contractor shall swab each section individually before installation with a five percent hypochlorite solution, to ensure clean piping.

B. Disinfection:
   1. Disinfect all potable and finished water piping.
   2. A suggested procedure for accomplishing complete and satisfactory disinfection is specified below. Other procedures will be considered for approval by the Director's Representative.
      a. Thoroughly flush piping prior to disinfection with water. For pipelines 24 inches in diameter and larger, pipelines shall be manually cleaned, carefully removing all sweepings, dirt and debris prior to disinfection.
      b. Conform to procedures described in AWWA C651. Continuous feed method of disinfecting shall be used unless alternative method is acceptable to Director's Representative.
   3. Water for initial flushing, testing and chlorination will be furnished by the State. Contractor shall provide all temporary

piping, hose, valves, appurtenances and services required. Cost of water required for redisinfection will be paid by Contractor to State at State's standard rates.

4. Chlorine will be supplied by Contractor.
5. Bacteriologic tests will be performed by State. A certified test laboratory report will be made available to Contractor, if requested.
6. Chlorine concentration in the water entering the piping shall be between 50 and 100 parts per million, such that a minimum residual concentration of 25 mg/l will be left after a 24-hour retention period. Care shall be taken to ensure disinfection of the piping in all its parts. The operation shall be repeated as necessary to provide complete disinfection.
7. After the required retention period, the heavily chlorinated water shall be flushed to the backwash lagoon, unless otherwise directed.

3.05 PIPING SCHEDULE

Service	Size	Material	DR/SDR	Pressure Class	Joint	Test
DW	≤ 3”	HDPE	11	250	FW	HY(120)
WW	≤ 6”	PVC	35		GS	LT
FM	≤ 2”	HDPE	9	250	FW	HY(120)

The following abbreviations are used in the piping schedule.

A. Service Abbreviations

Potable Drinking Water	DW
Waste Water	WW

B. Material Abbreviations

High Density Polyethylene	HDPE
PVC	PVC

C. Joint Abbreviations

Fusion Weld Gasketed	FW
	GS

E. Test Abbreviations

Hydrostatic Test (Pressure-psig) Water	HY ( )
Leakage (24Hrs.)	LT

END OF SECTION

SECTION 330517
COPPER PIPE

PART 1 GENERAL

1.01 DESCRIPTION

A. Scope:
   1. Contractor shall provide all labor, materials, equipment, and incidentals as shown, specified and required to furnish copper pipe and fittings.
   2. The extent of the piping is shown and specified in the piping schedules included in Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

B. Coordination:
   1. Review installation procedures under this and other Sections and coordinate the installation of items that must be installed with, or before, the copper pipe Work.
   2. Notify other contractors in advance of the installation of the copper pipe to provide them with sufficient time for the installation of items included in their contracts that must be installed with, or before, the copper pipe Work.

C. Related Sections:
   1. Section 15052, Exposed Piping Installation.
   2. Section 15055, Pipe Hangers and Supports.
   3. Division 15, Applicable Sections on Plumbing.

1.02 REFERENCES

A. Standards referenced in this Section are listed below:
   1. American Society for Testing and Materials, (ASTM).
      a. ASTM B 32, Specification for Solder Metal.
      b. ASTM B 42, Specification for Seamless Copper Pipe, Standard Sizes.
      c. ASTM B 68, Specification for Seamless Copper Tube, Bright Annealed.
      d. ASTM B 75, Specification for Seamless Copper Tube.
      e. ASTM B 88, Specification for Seamless Copper Water Tube.
      f. ASTM B 251, Specification for General Requirements for Wrought Seamless Copper and Copper-Alloy Tube.
      g. ASTM B 280, Specification for Seamless Copper Tube for Air-Conditioning and Refrigeration Field Service.
      h. ASTM B 302, Specification for Threadless Copper Pipe, Standard Sizes.
      i. ASTM B 306, Specification for Copper Drainage Tube (DWV).
   2. American Society of Mechanical Engineers, (ASME).
      a. ASME Boiler and Pressure Vessel Code.
   3. National Fire Protection Association, (NFPA).

4. Underwriters' Laboratories, Inc., (UL).

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with the applicable provisions and recommendations of the following, except as otherwise shown or specified:
   1. ASME, Boiler and Pressure Vessel Code.
   2. National Fire Protection Association, (NFPA).
   3. Underwriters' Laboratories, Incorporated, (UL).
   4. Local and State Building Codes and Ordinances.
   5. Permits: Contractor shall obtain and pay for all required permits, fees and inspections.

B. Component Supply and Compatibility:
   1. Obtain all equipment included in this Section regardless of the component manufacturer from a single copper pipe manufacturer.
   2. The copper pipe manufacturer to review and approve or to prepare all Shop Drawings and other submittals for all components furnished under this Section.
   3. All components shall be specifically constructed for the specified service conditions and shall be integrated into the overall assembly by the copper pipe manufacturer.

1.04 SUBMITTALS

A. Certificates: Submit certificates of compliance with Referenced Standards.

1.05 DELIVERY, STORAGE AND HANDLING

A. Refer to Section 15051, Buried Piping Installation, and Section 15052, Exposed Piping Installation.

PART 2 PRODUCTS

2.01 MATERIALS

A. Raw, Finished and Filtrate Lines: Raw, Filtrate, and Finished lines shall be seamless, bright annealed copper tubing, conforming to the applicable requirements of ASTM B 68. Pipe material shall be absolutely free from scale and dirt and maintained in such condition on delivery, storage, and installation. Dimensions and tolerances shall conform to ASTM B 251.

B. Potable Lines: Potable lines shall conform to the requirements of ASTM B 88. Underground, buried lines, unless otherwise specified, shall be Type K. All fittings shall be soldered, except at valves which may be flared or compression types.

2.02 JOINTING

A. All copper pipe shall be assembled with soldered type joints. Fittings shall conform to B16.23.

B. Soldered joints shall be 95-5 tin-antimony solder, conforming to the requirements of ASTM B 32.

C. All joints shall conform to manufacturer's recommendations and shall be made by skilled workmen.

D. Joints shall develop full strength and shall be greater than the pipe joined.

2.03 MARKING

A. All items shall be marked or labeled with the following information:
   1. Metal or alloy designation.
   2. Temper.
   3. Size and schedule.
   4. ASTM specification number.
   5. Name and location of supplier.

PART 3 EXECUTION

3.01 INSTALLATION

A. Refer to Section 15051, Buried Piping Installation, for buried piping installation, testing and cleaning.

B. Refer to Section 15052, Exposed Piping Installation, for exposed piping, installation, testing and cleaning.

C. Dielectric Protection: Copper tubing or fittings shall not be permitted to come in contact with steel piping, reinforcing steel or other steel at any location. Electrical checks shall be made to ensure no contact is made between copper tubing and steel elements. Wherever electrical contact is demonstrated by such test, Contractor shall provide dielectric protection.

END OF SECTION

SECTION 330531

PLASTIC PIPE AND FITTINGS

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 02200.

B. Buried Pipe Installation: Section 15051.

C. Disinfection Potable Waterlines: Section 02675.

1.02 SUBMITTALS

A. Product Data: Manufacturer's specifications with detailed information regarding dimensions, pressure rating, fittings and installation instructions. Manufacturer's data must indicate compliance with the standards specified herein.

PART 2 PRODUCTS

2.01 GENERAL

A. Each length of pipe (coils at 5 feet intervals) shall be marked to identify size, material type and grade, pressure rating, ASTM Designation, manufacturer

2.02 POLYVINYL CHLORIDE (PVC) PIPE

A. Pipe Material: PVC 1120 or PVC 1220.

B. Pipe used underground in sizes 1-1/2 inches and larger shall be joined using rubber gasketed bells or couplings.

C. PVC pipe, SDR-PR; (Standard Dimension Ratio-Pressure Rated): ASTM D 2241.

D. PVC pipe, Schedule 40: ASTM D 1785.

E. PVC Pipe with integral bell-end for gasketed joints

F. Pipe shall be of the size, schedule, SDR, and pressure rating shown on the drawings or specified below.

PRESSURE RATINGS FOR PVC 1120 AND PVC 1220 NON-THREADED PIPE AT 23 DEGREES C (73.40 F)			
SDR	**PR (PSI)**	**SIZE (IN)**	**SCH.40 PR (PSI)**
13.5	315	1/2	600
17	250	3/4	480
21	200	1	450
26	160	1-1/2	330
32.5	125	2	280
41	100	3	260
64	63	4	220
		6	180

2.03 POLYETHYLENE (PE) PIPE

A. Pipe Material: PE 3306 or PE 3406.

B. PE Pipe; SDR-PR: ASTM D 2239.

C. PE Pipe, SDR-PR (based on controlled outside diameter): ASTM D 3035.

D. Pipe shall be of the size, SDR and pressure rating shown on the drawings or specified below.

PRESSURE RATINGS FOR PE 3306 AND PE 3406 AT 23 DEGREES C (73.40 F)	
SDR	**PR (PSI)**
5.3	200
7	160
9	125
11 (OD)	125
11.5	100
13.5 (OD)	100
15	80
17 (OD)	80

2.04 PLASTIC FITTINGS

A. Fittings shall be of the same size and pressure rating as the pipe to which they are connected.

B. Fittings shall be as recommended by the pipe manufacturer and shall meet the appropriate Standard listed below.

PVC Socket Type, Schedule 40: ASTM D 2466.

2.06 SOLVENT CEMENT AND JOINTS

A. Rubber Gasketed Joints: ASTM D 3139.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect pipe and fittings before installation. Remove defective materials from the site.

3.02 GENERAL

A. Install pipe in accordance with the manufacturer's recommendations.

B. Underground Pipe: Install in accordance with ASTM D 2774.

3.03 INSTALLATION

A. Install pipe where and as shown on the drawings.

B. Pipe in Trenches:
   1. Keep trenches free from water.
   2. Grade and shape trench bottom to insure a firm uniform bearing for the entire trench length. Provide a minimum cover of 4'-6" to finished grade unless otherwise shown on the drawings.
   3. Cut pipe as recommended by the manufacturer.
   4. At each joint, dig a bell hole sufficiently wide and deep to allow the pipe barrel to bear uniformly on the trench bottom.
   5. Construct concrete thrust blocks behind bends, tees, caps and plugs as shown on the drawings. Cast concrete against undisturbed earth.

3.04 PROTECTING PIPE

A. During the progress of the Work keep pipe clean from all sediment,

debris, and other foreign material.

B. Close all open ends of pipes and fittings securely with removable plugs at end of Work day, during storms, when the Work is left at any time, and at such times as the Director's Representative may direct.

3.05 PERFORMANCE

A. Description: Before testing, backfill or otherwise brace the pipe barrels between joints to prevent movement under pressure.

B. Hydrostatic Test: Before testing, backfill or otherwise brace the pipe barrels between joints to prevent movement under pressure.
   1. Before the pipe joints, fittings, valves, or other appurtenances are covered, expel and test the main for two hours at 1.5 times the pressure rating(s) listed for the various types of pipe specified in Part 2.
   2. Remove all defective pipe, fittings, valves and appurtenances and replace with sound pipe, fittings, valves, or appurtenances, and repair all joints showing visible leaks until tight and repeat the test until satisfactory to the Director's Representative.

C. Leakage Test:
   1. Conduct a leakage test after the pressure test has been satisfactorily completed.
   2. Leakage is defined as the quantity of water to be supplied into the laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.
   3. The duration of each leakage test shall be two hours.
   4. During the leakage test subject the pipe to its rated pressure.
   5. No pipe installation will be accepted until the leakage is not more than the number of gallons per hour as determined by the following formula:

      L - ND X the square root of P 7400

      in which:

      L = allowable leakage in gallons per hour

      N = number of joints in length of pipe line tested D = nominal

      diameter of pipe, inches

      P = average test pressure during the leakage test (PSI)

   6. Should any test of pipe disclose leakage greater than that computed by the above formula, locate and repair the defects so

that the leakage is within the specified allowance. The hydrostatic and leakage tests shall be made on such lengths of pipe and in such manner as the Director's Representative shall direct and in his presence. Keep trenches free from water to the satisfaction of the Director's Representative until the completion of the tests.

D. Connections:

1. Make connections between the pipe lines installed under this contract and the existing pipe lines or structures shown on the drawings. Should it be impossible to make a connection shown on the drawings because the pipe with which the connection is shown to be made has not yet been installed, lay the pipe to a point directed by the Director's Representative and plug or cap the end in a satisfactory manner; identify the terminal point with a stake extending above ground marked to indicate the pipe size and service.

END OF SECTION

SECTION 330533

CORRUGATED POLYETHYLENE STORM DRAIN PIPE AND FITTINGS

PART 1 GENERAL

1.01 RELATED WORK SPECIFIED ELSEWHERE

A. Earthwork: Section 02300.

1.02 SUBMITTALS

A. Product Data: Manufacturer's specifications (AASHTO M-252 or AASHTO M-294), including dimensions, allowable height of cover information, and installation instructions.

PART 2 PRODUCTS

2.01 MANUFACTURERS (OR APPROVED EQUAL)

A. Advanced Drainage Systems, Inc., 4640 Trueman Boulevard, Hilliard, OH 43026. (800) 821-6710

B. Hancor, Inc., 401 Olive St., Findlay, OH 45840; (800) 847-5880.

2.02 MATERIALS

A. Corrugated Polyethylene Pipe and Fittings: Conform to AASHTO M-252 (4 to 10-inch diameter) or AASHTO M-294 (12 to 36-inch diameter).

1. Coefficient of Roughness (interior pipe surface): 0.020 maximum (Manning formula).

1. Classification: Type C.

3. Design Strength (all sizes): 50 feet allowable height of cover.

4. Joint Couplings: Polyethylene Couplers; snap-on type or split collar through 24-inch diameter; screw-on type where applicable.

5. Material Properties: High density polyethylene meeting the requirements of ASTM D 3350, Cell Classification 324420C; or ASTM 1248, Type III, Class C, Category 4, Grade P33.

1. Conform to shape, dimensions, and thickness shown on the drawings.

2. Use only extra length rod and lug-type, galvanized coupling band connectors.

PART 3 EXECUTION

3.01 INSTALLATION

A. Laying: Lay pipe to indicated line and grade with a firm uniform bearing for the entire length of the pipe. Fill excess excavation with suitable materials and tamp.

B. Joints: Install coupling and fasten per manufacturer's instructions.

C. Connections:

1. Make connections to existing pipe by using a galvanized steel "dimple"-type coupling. Remake damaged existing joints.

2. Make connections to existing manholes and drainage structures by cutting into the floor or bench of the manhole or drainage structure and forming a new channel.

3. If the pipe, manholes or other structures with which connections are to be made have not yet been installed, install the pipe to a point directed by the Director's Representative and plug or cap the end in a satisfactory manner.

END OF SECTION

SECTION 331419

VALVES

PART 1 GENERAL

1.01 SUBMITTALS

A. Valve Schedule: Submit the valve schedule listing type of valve, manufacturer's model number and size, for each valve type required.

B. Product Data: Catalog sheets and specifications for each valve type and size and all other items required by this Section.

1.02 QUALITY ASSURANCE

A. Requirements of Regulatory Agencies:

1. Valves, pressure reducing and relief devices shall conform to the specifications, regulations and requirements of all Agencies (Federal, State and Local), Codes, Local Gas and Power Companies and Associations having jurisdiction governing construction, sizing, application and location of same.

2. Gate valves, 3 inches in size and larger, shall conform to AWWA Specification C-500.

PART 2 PRODUCTS

2.01 VALVES

A. Valves shall be first quality, free from all imperfections and defects, with body markings indicating manufacturer and rating. Valve parts of the same manufacturer, size and type shall be interchangeable. Manually operated valves shall open in a counter-clockwise direction, and in general, round ventilated type handwheels shall be provided. All valves, which use packing, shall be capable of being packed when wide open and under full working pressure.

B. All valves shall have a minimum operating pressure of 150 psi OWG, factory tested at double the working pressure.

C. Valve flanges shall be of class to mate with pipe flanges.

D. All valve types 3 inches in size and larger shall have iron bodies and bronze trim.

E. Valve ends, unless otherwise noted or shown, shall be as follows: Flanged ends for steel and brass pipe sizes 4 inches and larger; mechanical joint,

rubber ring, joint or flanged joint for cast iron/ductile iron pipe to match joints of piping furnished.

2.02 MATERIALS

A. Body:

1. Cast Iron: ASTM A-126-73 Class B, higher strength cast iron.

2. Bronze: For use up to 150 WSP, ASTM B-62-74 and over 150 to 300 psig WSP, ASTM B-61-74.

B. Stem:

1. Cast Manganese Bronze: ASTM B-584.

2. Cast Silicon Brass: ASTM B-584.

3. Rolled Silicon Brass: ASTM B-98 Alloy D.

4. Rolled Aluminum Bronze: ASTM B-150 Alloy 1.

5. Rolled Manganese Bronze: ASTM B-138 Alloy A (half hard).

6. Naval Brass: ASTM B-21 Alloy A or Alloy C (hard).

2.03 GATE VALVES

A. All gate valves shall have gates of the double disc or split wedge type. Valves 2 inches in size and larger buried in the ground shall be iron body, inside screw with bronze trim. Valves under 2 inches in size shall be all-bronze unless otherwise indicated. Gate valves installed inside structures or in pits shall be of the outside screw and yoke type, unless otherwise noted. Valve spindle and the nut in which the screw operates shall be bronze. Furnish valves 3 inches in size and larger with 2- inch square nuts or wheels as required. Valves less than 3 inches in size shall have T or flat heads, so as to allow for an operating rod to be secured thereto, or they shall have hand wheel operators where required. Valves shall open in a counter-clockwise direction, unless otherwise required to match existing valves at the Facility. Provide extension stems and guides when required by the location. Furnish gate valves 3 inches in size and larger, the product of one manufacturer, similar to the product as manufactured by Eddy Valve Co., Kennedy Valve Co. or Ludlow Valve Co.

B. Type D Valves: 200 psig OWG, 350 psig hydrostatic test, bronze body, solder ends. Approved Valves: Fairbanks 0282, Jenkins 1242, Kennedy 425 SJ.

2.04 CURB STOPS

A. Round-way, ground key type unless otherwise noted. Acceptable Manufacturer: Mueller.

2.05 VALVE BOXES

A. Cast iron adjustable type box and cover extending from the valve to final grade. Cover of box shall be complete with an indicating arrow cast on it denoting direction of valve opening.

2.06 VALVE KEYS

A. Furnish one steel socket key for each valve of the same size or less. Acceptable Manufacturer: Mueller Co.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install valves of type and kind as indicated on the drawings, each complete with operator and accessory items as required by the actual location. Size valves the same size as the piping in which they are installed, unless otherwise indicated.

3.02 VALVE BOXES

A. Install a valve box and cover, extending from the valve to final grade, for each gate valve buried in the ground.

END OF SECTION

SECTION 344113

TRAFFIC SIGNS

PART 1 GENERAL

1.01 SUBMITTALS

A. Shop Drawings: Show shop drawings, not necessarily to scale, but sufficient enough in detail to show color, wording, lettering size and style, overall sign size, construction details and installation details for each type of sign.

PART 2 PRODUCTS

2.01 TRAFFIC SIGNS

A. Construction Materials: Comply with the applicable requirements of DOT Section 645.

B. Posts: Galvanized steel.

PART 3 EXECUTION

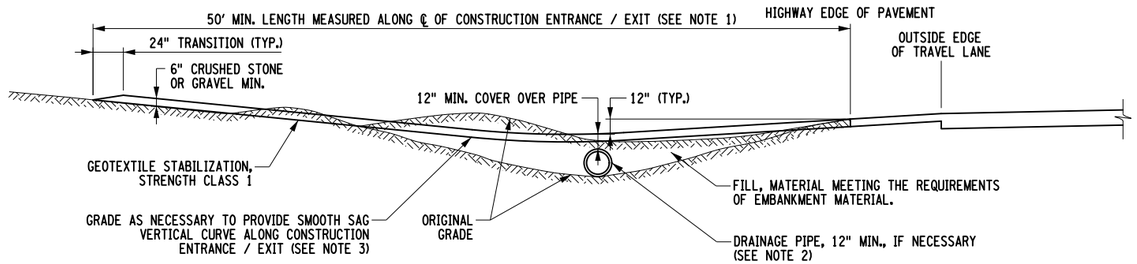
3.01 INSTALLATION

A. Erect signs in their designated locations, as indicated and in accordance with the approved shop drawings and the applicable requirements of DOT Section 645.

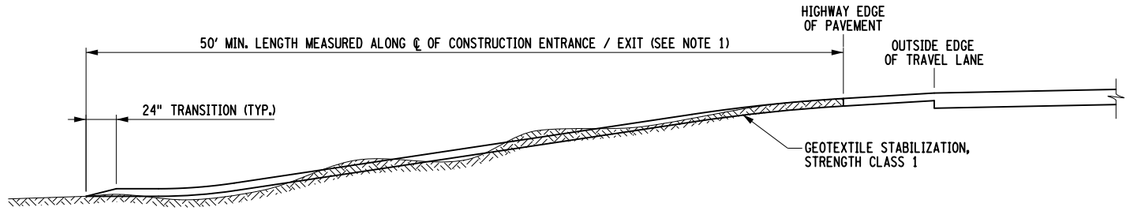
B. Protect surfaces and finishes from abrasion and other damage during handling and installation.

C. Replace damaged or faulty signs.

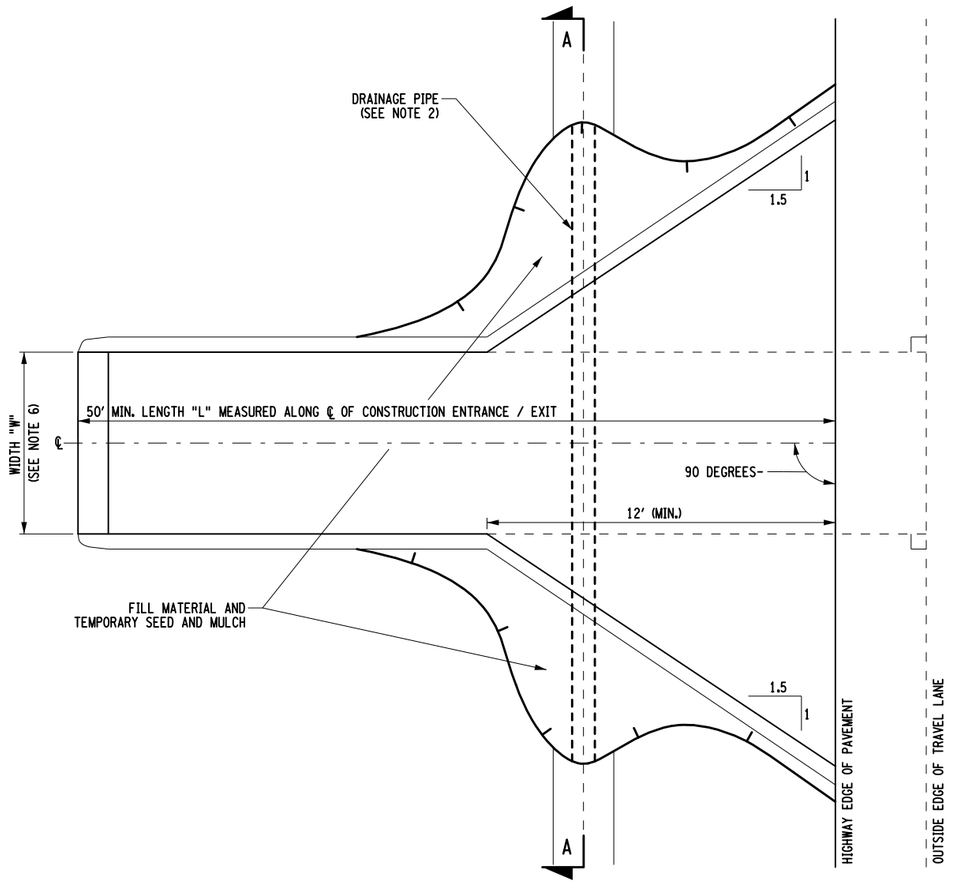
END OF SECTION



TYPICAL CONSTRUCTION ENTRANCE / EXIT PROFILE
(CUT AND DITCH SECTIONS)



TYPICAL CONSTRUCTION ENTRANCE / EXIT PROFILE
(FILL SECTIONS)



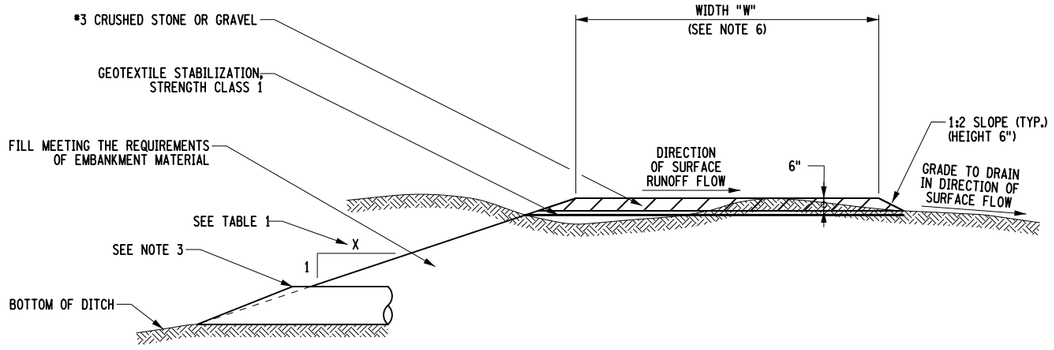
TYPICAL CONSTRUCTION ENTRANCE / EXIT PLAN
(CUT/DITCH AND FILL SECTIONS)

APPLICATION NOTES:

A. THE PURPOSE OF A STABILIZED CONSTRUCTION ENTRANCE/EXIT IS TO REDUCE OR ELIMINATETHE TRACKING OF SEDIMENT ONTO PUBLIC RIGHTS OF WAY OR STREETS.

GENERAL NOTES:

1. MODIFICATIONS MAY BE REQUIRED TO MATCH FIELD CONDITIONS.
2. PROPOSED DRAINAGE PIPES SHALL BE SIZED WITH SUFFICIENT CAPACITY TO CARRY DITCH FLOWS (12" MIN.). ALTERNATIVE WAYS OF TRANSPORTING DITCH DRAINAGE ACROSS CONSTRUCTION ENTRANCE / EXIT MAY BE PROPOSED BY THE CONTRACTOR FOR APPROVAL BYTHE ENGINEER.
3. DRAINAGE PIPES OVER 20" DIA. THAT ARE NOT BEHIND A ROADSIDE BARRIER SHALL INCLUDE SAFETY END SECTIONS OR GRATING TO ENSURE TRAVERSABILITY.
4. THE CONTRACTOR SHALL GRADE TO PREPARE AND SMOOTH ORIGINAL GROUND, PLACE GEOTEXTILE OVER THE ENTIRE AREA THEN PLACE 6" OF #3 CRUSHED STONE OR GRAVEL ENTRANCE MATERIAL UP TO THE EDGE OF PAVEMENT.
5. LAYOUT DRIVEWAY OPENING PER TAPER METHOD OF LAYOUT FOR A MINOR COMMERCIAL DRIVEWAY ON STANDARD SHEET 608-03.
6. DETERMINE DRIVEWAY WIDTH "W" FROM THE MINOR COMMERCIAL DRIVEWAY CLASSIFICATION OF TABLE 1 ON STANDARD SHEET 608-03.
7. INSPECT THE CONSTRUCTION ENTRANCE / EXIT AT LEAST WEEKLY FOR SEDIMENT ACCUMULATION WITHIN THE STONE SURFACE AND FOR GENERAL SURFACE CONDITION.
8. PERIODIC MAINTENANCE IS REQUIRED IF SEDIMENT IS TRACKED ONTO PAVEMENT AND COST OF MAINTENANCE WILL BE INCLUDED IN THE UNIT PRICE BID.



TYPICAL CONSTRUCTION ENTRANCE / EXIT SECTION A - A

TABLE 1	
X	HIGHWAY SPEED CONDITION
2	ALL SPEEDS - PROTECTED BY BARRIER
3	< 50 MPH
6	≥ 50 MPH

Appendix A - New York State Department of Transportation Standard Sheet No. 209-05: Construction Entrance / Exit from EB 17-001.

NEW YORK STATE OF OPPORTUNITY. Department of Transportation

U.S. CUSTOMARY STANDARD SHEET

CONSTRUCTION ENTRANCE / EXIT

APPROVED JANUARY 26, 2017
/S/ RICHARD WILDER, P.E.
DEPUTY CHIEF ENGINEER (DESIGN)

ISSUED UNDER EB 17-001

209-05

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