

## DOCUMENT 003119 - EXISTING CONDITION INFORMATION

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 1.1 EXISTING CONDITION INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of the Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. Existing drawings that include information on existing conditions including previous construction at Project site are available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner]**.
- C. Existing **[specifications] [and] [submittals]** that include information on existing conditions including previous construction at Project site are available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner]**.
- D. Survey information that includes information on existing conditions, prepared by **<Insert survey firm name>**, dated **<Insert date of survey>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [as part of Drawings]**.
- E. Photographic report of existing conditions that includes photographic documentation on existing conditions, prepared by **<Insert photography firm name>**, dated **<Insert date of report>**, is available **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of the Owner] [as appended to this Document]**.
- F. **<Insert additional information items>** are available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner]**.
- G. Related Requirements:
  - 1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
  - 2. Document 003126 "Existing Hazardous Material Information" for hazardous materials reports that are made available to bidders.
  - 3. Document 003132 "Geotechnical Data" for reports and soil-boring data from geotechnical investigations that are made available to bidders.

END OF DOCUMENT 003119

## DOCUMENT 003126 - EXISTING HAZARDOUS MATERIAL INFORMATION

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## 1.1 EXISTING HAZARDOUS MATERIAL INFORMATION

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information, but are not a warranty of existing conditions. This Document and its attachments are not part of the Contract Documents.
- B. An existing asbestos report for Project, prepared by **<Insert agency or firm name>**, dated **<Insert date of report>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner] [as appended to this Document]**.
- C. An existing lead report for Project, prepared by **<Insert agency or firm name>**, dated **<Insert date of report>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner] [as appended to this Document]**.
- D. An existing PCB (Polychlorinate Biphenyl) information report for Project, prepared by **<Insert agency or firm name>**, dated **<Insert date of report>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner] [as appended to this Document]**.
- E. An existing mold report for Project, prepared by **<Insert agency or firm name>**, dated **<Insert date of report>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner] [as appended to this Document]**.
- F. Related Requirements:
  - 1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
  - 2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.
  - 3. Document 003132 "Geotechnical Data" for reports and soil-boring data from geotechnical investigations that are made available to bidders.
  - 4. Section 024116 "Structure Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.

5. Section 024119 "Selective Structure Demolition" for notification requirements if materials suspected of containing hazardous materials are encountered.

END OF DOCUMENT 003126

## DOCUMENT 003132 - GEOTECHNICAL DATA

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## 1.1 GEOTECHNICAL DATA

- A. This Document with its referenced attachments is part of the Procurement and Contracting Requirements for Project. They provide Owner's information for Bidders' convenience and are intended to supplement rather than serve in lieu of Bidders' own investigations. They are made available for Bidders' convenience and information. This Document and its attachments are not part of the Contract Documents.
- B. Because subsurface conditions indicated by the soil borings are a sampling in relation to the entire construction area, and for other reasons, the Owner, the Architect, the Architect's consultants, and the firm reporting the subsurface conditions do not warrant the conditions below the depths of the borings or that the strata logged from the borings are necessarily typical of the entire site. Any party using the information described in the soil borings and geotechnical report shall accept full responsibility for its use.
- C. Soil-boring data for Project, obtained by **<Insert agency or firm name>**, dated **<Insert date of logs>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner] [as appended to this Document]**.
- D. A geotechnical investigation report for Project, prepared by **<Insert agency or firm name>**, dated **<Insert date of report>**, is available for viewing **[on Project Web site] [at the office of Architect] [at the office of Construction Manager] [at the office of Owner] [as appended to this Document]**.
  1. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.
  2. Any party using information described in the geotechnical report shall make additional test borings and conduct other exploratory operations that may be required to determine the character of subsurface materials that may be encountered.
- E. Related Requirements:
  1. Document 002113 "Instructions to Bidders" for the Bidder's responsibilities for examination of Project site and existing conditions.
  2. Document 003119 "Existing Condition Information" for information about existing conditions that is made available to bidders.

3. Document 003126 "Existing Hazardous Material Information" for hazardous materials reports that are made available to bidders.

END OF DOCUMENT 003132

SECTION 010000 - GENERAL REQUIREMENTS

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PART 1 - GENERAL (Not Used)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010000

## SECTION 011000 - SUMMARY

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## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work by Owner.
5. Work under separate contracts.
6. Future work.
7. Purchase contracts.
8. Owner-furnished products.
9. Contractor-furnished, Owner-installed products.
10. Access to site.
11. Coordination with occupants.
12. Work restrictions.
13. Specification and Drawing conventions.
14. Miscellaneous provisions.

## B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

## 1.3 PROJECT INFORMATION

- A. Project Identification: **<Insert Project identifier such as Project name and number>**.

1. Project Location: **<Insert Project location (street address, city, and state)>**.



- B. Owner: **<Insert name and address of Owner>**.
1. Owner's Representative: **<Insert name and contact information for Owner's representative>**.
- C. Architect: **<Insert name and contact information for Architect>**.
- D. Architect's Consultants: Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. **<Insert title of design discipline>**: **<Insert name and contact information for consultant>**.
- E. Other Owner Consultants: Owner has retained the following design professionals who have prepared designated portions of the Contract Documents:
1. **<Insert title of design discipline>**: **<Insert name and contact information for consultant>**. **<Insert title of design discipline>** has prepared the following portions of the Contract Documents:
    - a. **<Insert description of scope of service for other Owner consultant>**.
- F. Contractor: **<Insert name and contact information for Contractor>** has been engaged as Contractor for this Project.
- G. Construction Manager: **<Insert name and contact information for Construction Manager>**.
1. Construction Manager has been engaged for this Project to serve as an advisor to Owner and to provide assistance in administering the Contract for construction between Owner and **[ each ]** Contractor, according to a separate contract between Owner and Construction Manager.
    - a. Construction Manager also serves as Project coordinator as defined in Section 011200 "Multiple Contract Summary."
  2. Construction Manager for this Project is Project's constructor. The terms "Construction Manager" and "Contractor" are synonymous.
- H. Design-Builder: **<Insert name and contact information for Design-Builder>**.
1. Design-Builder has been engaged for this Project to provide architectural and engineering services and to serve as Project's constructor. The terms "Design-Builder" and "Contractor" are synonymous.
- I. Project Coordinator for Multiple Contracts: **<Insert name and contact information for Project coordinator>** has been engaged by Owner to serve as Project coordinator.
- J. Project Coordinator for Multiple Contracts: Owner shall serve as Project coordinator.
- K. Project Mechanical/Electrical Coordinator for Multiple Contracts:

1. **<Insert name and contact information for mechanical/electrical Project coordinator>** has been engaged by Owner to serve as Project coordinator.
2. **[HVAC Contractor] [Electrical Contractor] [Plumbing Contractor] [Construction Manager] <Insert entity>** shall act as mechanical/electrical coordinator.

L. Web-Based Project Software: Project software administered by **[Architect] [Owner] [Construction Manager] [Contractor]** will be used for purposes of managing communication and documents during the construction stage.

1. See Section 013100 "Project Management and Coordination." for requirements for **[establishing] [administering] [and]** using web-based Project software.

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

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

1. **<Insert a brief description of Project indicating the size, code classification for occupancy and construction type, and general description of major building assemblies>** and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract.
2. Project will be constructed under coordinated, concurrent multiple contracts. See Section 011200 "Multiple Contract Summary" for a description of work included under each of the multiple contracts and for the responsibilities of Project coordinator. Contracts for this Project include the following:
  - a. **<Insert name of the Contract>**.

#### 1.5 PHASED CONSTRUCTION

A. The Work shall be conducted in **<Insert number>** phases, with each phase substantially complete as indicated.

1. Phase **<Insert designation>**: **<Briefly describe work of this phase>** Work of this phase shall commence **[within <Insert number of days> after the Notice to Proceed] [by <Insert date>]** and be substantially complete and ready for occupancy **[within <Insert number of days>] [after the Notice to Proceed] [after commencement of construction of this phase] [by <Insert date>]**.
2. Phase **<Insert designation>**: The remaining Work shall be substantially complete and ready for occupancy at time of Substantial Completion for the Work.

B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates[, **and move-out and -in dates of Owner's personnel**] for all phases of the Work.

## 1.6 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will perform the following construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
  - 1. **<Insert a brief description of work performed by Owner>.**
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
  - 1. **<Insert a brief description of work performed by Owner>.**
- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory Work under this Contract.
  - 1. **<Insert a brief description of work performed by Owner>.**

## 1.7 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under separate contracts.
- B. Preceding Work: Owner [**has awarded**] [**will award**] separate contract(s) for the following construction operations at Project site. Those operations are scheduled to be substantially complete before Work under this Contract begins.
  - 1. **<Insert name of the Contract>: To <Insert name of separate Contractor> [to] [for] <Insert a brief description of work performed under separate contract>.**
- C. Concurrent Work: Owner [**has awarded**] [**will award**] [**and will assign to Contractor**] separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
  - 1. **<Insert name of the Contract>: To <Insert name of separate Contractor> [to] [for] <Insert a brief description of work performed under separate contract>.**
- D. Subsequent Work: Owner [**has awarded**] [**will award**] separate contract(s) for the following additional work to be performed at site following Substantial Completion. Completion of that work will depend on successful completion of preparatory Work under this Contract.
  - 1. **<Insert name of the Contract>: To <Insert name of separate Contractor> [to] [for] <Insert a brief description of work performed under separate contract>.**

## 1.8 FUTURE WORK

- A. The Contract Documents include requirements that will allow Owner to carry out future work following completion of this Project; provide for the following future work:
1. **<Insert description of future work requiring consideration during construction of the Work of this Contract>.**

## 1.9 PURCHASE CONTRACTS

- A. General: Owner has negotiated Purchase contracts with suppliers of material and equipment to be incorporated into the Work. Owner will assign these Purchase contracts to Contractor. Include costs for purchasing, receiving, handling, storage if required, and installation of material and equipment in the Contract Sum unless otherwise indicated.
1. Contractor's responsibilities are same as if Contractor had negotiated Purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.
- B. Purchase Contracts Information:
1. **<Insert product name>**: See Section **<Insert Section number>** "**<Insert Section title>**."
    - a. Purchase Contract Firm and Representative: **<Insert name and contact information for Purchase contract firm and representative>**.
    - b. Purchase Contract Scope: **[Furnishing material] [Material and installation labor] <Insert description of contract>**.
    - c. Purchase Status: **[Price negotiated by Owner, to be incorporated into the Contract Sum by Contractor; see Section 012100 "Allowances" for cash allowance for Purchase contract] [Price negotiated and incorporated into the Contract Sum by Contractor] [Product reserved by Owner] [Order placed and deposit paid by Owner] [Order to be placed by Contractor] <Insert description of status of Purchase contract>**.
    - d. Quantity: **<Insert quantity ordered>**.
    - e. Other Requirements: **<Insert special requirements>**.

## 1.10 OWNER-FURNISHED PRODUCTS

- A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products[ **and making building services connections**].
- B. Owner-Furnished Products:
1. **<Insert description, in separate subparagraphs, for each Owner-furnished product>**.

## 1.11 CONTRACTOR-FURNISHED, OWNER-INSTALLED PRODUCTS

- A. Contractor shall furnish products indicated. The Work includes unloading, handling, storing, and protecting Contractor-furnished products as directed and turning them over to Owner at Project closeout.
- B. Contractor-Furnished, Owner-Installed Products:
  - 1. **<Insert description, in separate subparagraphs, for each Contractor-furnished, Owner-installed product>.**

## 1.12 ACCESS TO SITE

- A. General: **[Each ]**Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project.
- B. General: **[Each ]**Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- C. Use of Site: Limit use of Project site to **[Work in areas] [areas within the Contract limits]** indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Limits: Confine construction operations to **<Insert description of areas where work is permitted>**.
  - 2. **<Double click to insert sustainable design text for site disturbance.>**
  - 3. Driveways, Walkways and Entrances: Keep driveways[ **parking garage,**] [ **loading areas,**] and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- D. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- E. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

## 1.13 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and **[existing] [adjacent]** building(s) during entire construction period. Cooperate with Owner during construction operations to minimize

conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.

1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
2. Notify Owner not less than [72] <Insert number> hours in advance of activities that will affect Owner's operations.

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

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

C. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.

1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

#### 1.14 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

B. On-Site Work Hours: Limit work in the existing building to normal business working hours of <Insert time> a.m. to <Insert time> p.m., Monday through Friday, unless otherwise indicated.

1. Weekend Hours: <Insert restrictions on times permitted for weekend work>.

2. Early Morning Hours: **<Insert restrictions or references to regulations by authorities having jurisdiction for restrictions on noisy work>**.
  3. Hours for Utility Shutdowns: **<Insert Owner's restrictions>**.
  4. Hours for **[Core Drilling]** **<Insert noisy activity>**: **<Insert Owner's restrictions>**.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
1. Notify **[Architect]** **[Construction Manager]** **[Owner]** not less than **[two]** **<Insert number>** days in advance of proposed utility interruptions.
  2. Obtain **[Architect's]** **[Construction Manager's]** **[Owner's]** written permission before proceeding with utility interruptions.
- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.
1. Notify **[Architect]** **[Construction Manager]** **[Owner]** not less than **[two]** **<Insert number>** days in advance of proposed disruptive operations.
  2. Obtain **[Architect's]** **[Construction Manager's]** **[Owner's]** written permission before proceeding with disruptive operations.
- E. [<Double click to insert sustainable design text for nonsmoking buildings.>](#)
- F. Restricted Substances: Use of tobacco products and other controlled substances **[within the existing building]** **[on Project site]** is not permitted.
- G. Employee Identification: **[Provide]** **[Owner will provide]** identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
- H. Employee Screening: Comply with Owner's requirements for **[drug]** **[and]** **[background]** screening of Contractor personnel working on Project site.
1. Maintain list of approved screened personnel with Owner's representative.

#### 1.15 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.

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

#### 1.16 MISCELLANEOUS PROVISIONS

- A. <Insert miscellaneous provisions>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000



## SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

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## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
1. General coordination procedures.
  2. Coordination drawings.
  3. RFIs.
  4. Digital project management procedures.
  5. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
  2. Section 013200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  3. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  4. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.
  5. Section 019113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

## 1.3 DEFINITIONS

- A. BIM: Building Information Modeling.

- B. RFI: Request for Information. Request from Owner, [**Construction Manager**, ]Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within [**15**] <Insert number> days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
  - 1. Post copies of list in project meeting room, in temporary field office, [**in web-based Project software directory**, ]and in prominent location in [**each**] built facility. Keep list current at all times.

#### 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination: Each contractor shall [**cooperate with Project coordinator who shall**] coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.

3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities[ **and scheduled activities of other contractors**] [**and direction of Project coordinator**] to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
  2. Preparation of the schedule of values.
  3. Installation and removal of temporary facilities and controls.
  4. Delivery and processing of submittals.
  5. Progress meetings.
  6. Preinstallation conferences.
  7. Project closeout activities.
  8. Startup and adjustment of systems.

## 1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Coordinate the addition of trade-specific information to coordination drawings [**by multiple contractors**] in a sequence that best provides for coordination of the information and resolution of conflicts between installed components before submitting for review.
    - c. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - d. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - e. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - f. Indicate required installation sequences.

- g. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

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

1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
2. Plenum Space: Indicate subframing for support of ceiling[, **raised access floor**,] and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
6. Mechanical and Plumbing Work: Show the following:
  - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
  - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
  - c. Fire-rated enclosures around ductwork.
7. Electrical Work: Show the following:
  - a. Runs of vertical and horizontal conduit **1-1/4 inches (32 mm)** in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
  - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
8. Fire-Protection System: Show the following:
  - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
9. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared

- in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make suitable modifications and resubmit.
10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."
- C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.
  2. File Preparation Format: **[DWG] [DXF] [DGN]**, Version **<Insert designation>**, operating in **[Microsoft Windows] [Apple Macintosh]** operating system.
  3. File Submittal Format: Submit or post coordination drawing files using **[format same as file preparation format] [PDF format]**.
  4. BIM File Incorporation: **[Develop and incorporate] [Construction Manager will incorporate Contractor's]** coordination drawing files into BIM established for Project.
    - a. **[Perform] [Construction Manager will perform]** three-dimensional component conflict analysis as part of preparation of coordination drawings. Resolve component conflicts prior to submittal. Indicate where conflict resolution requires modification of design requirements by Architect.
  5. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
    - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
    - b. Digital Data Software Program: Drawings are available in **<Insert name and version of digital data software program and operating system>**.
    - c. Contractor shall execute a data licensing agreement in the form of **[AIA Document C106] [Agreement included in this Project Manual] [Agreement form acceptable to Owner and Architect]**.

## 1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Architect will return without response those RFIs submitted to Architect by other entities controlled by Contractor.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
  2. Project number.
  3. Date.

4. Name of Contractor.
  5. Name of Architect[ **and Construction Manager**].
  6. RFI number, numbered sequentially.
  7. RFI subject.
  8. Specification Section number and title and related paragraphs, as appropriate.
  9. Drawing number and detail references, as appropriate.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: [AIA Document G716] [Form bound in Project Manual] [Software-generated form with substantially the same content as indicated above, acceptable to Architect].
1. Attachments shall be electronic files in PDF format.
- D. Architect's[ **and Construction Manager's**] Action: Architect[ **and Construction Manager**] will review each RFI, determine action required, and respond. Allow [seven] <Insert number> working days for Architect's response for each RFI. RFIs received by Architect[ **or Construction Manager**] after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt by Architect [**or Construction Manager**] of additional information.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect[ **and Construction Manager**] in writing within [10] <Insert number> days of receipt of the RFI response.

- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log [weekly] <Insert time>. [Use software log that is part of web-based Project software.] [Include the following:] [Software log with not less than the following:]
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect[ **and Construction Manager**].
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's[ **and Construction Manager's**] response was received.
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
  9. Identification of related Field Order, Work Change Directive, and Proposal Request, as appropriate.
- F. On receipt of Architect's[ **and Construction Manager's**] action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect[ **and Construction Manager**] within [seven] <Insert number> days if Contractor disagrees with response.

#### 1.8 DIGITAL PROJECT MANAGEMENT PROCEDURES

- A. Architect's Data Files Not Available: Architect will not provide Architect's [BIM model] [CAD drawing] digital data files for Contractor's use during construction.
- B. Use of Architect's Digital Data Files: Digital data files of Architect's [BIM model] [CAD drawings] will be provided by Architect for Contractor's use during construction.
1. Digital data files may be used by Contractor in preparing coordination drawings, Shop Drawings, and Project record Drawings.
  2. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Contract Drawings.
  3. Digital Drawing Software Program: Contract Drawings are available in <Insert name and version of digital drawing software program and operating system>.
  4. Contractor shall execute a data licensing agreement in the form of [AIA Document C106 Digital Data Licensing Agreement] [Agreement included in Project Manual] [Agreement form acceptable to Owner and Architect].
    - a. Subcontractors, and other parties granted access by Contractor to Architect's digital data files shall execute a data licensing agreement in the form of [AIA Document C106] [Agreement included in this Project Manual] [Agreement acceptable to Owner and Architect].
  5. <Insert additional conditions on which digital data drawing files will made available>.
  6. The following digital data files will be furnished for each appropriate discipline:
    - a. Floor plans.
    - b. Reflected ceiling plans.

- c. <Insert name of digital data file>.
- C. Web-Based Project Software: **[Provide, administer, and use]** **[Use Architect's]** **[Use Owner's]** **[Use Construction Manager's]** web-based Project software site for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project software site includes, at a minimum, the following features:
    - a. Compilation of Project data, including Contractor, subcontractors, Architect, architect's consultants, Owner, and other entities involved in Project. Include names of individuals and contact information.
    - b. Access control for each entity for each workflow process, to determine entity's digital rights to create, modify, view, and print documents.
    - c. Document workflow planning, allowing customization of workflow between project entities.
    - d. Creation, logging, tracking, and notification for Project communications required in other Specification Sections, including, but not limited to, RFIs, submittals, Minor Changes in the Work, Construction Change Directives, and Change Orders.
    - e. Track status of each Project communication in real time, and log time and date when responses are provided.
    - f. Procedures for handling PDFs or similar file formats, allowing markups by each entity. Provide security features to lock markups against changes once submitted.
    - g. Processing and tracking of payment applications.
    - h. Processing and tracking of contract modifications.
    - i. Creating and distributing meeting minutes.
    - j. Document management for Drawings, Specifications, and coordination drawings, including revision control.
    - k. Management of construction progress photographs.
    - l. Mobile device compatibility, including smartphones and tablets.
    - m. <Insert description of software feature>.
  2. Provide up to **[seven]** <Insert number> web-based Project software user licenses for use of Owner[, **Owner's Commissioning Authority**] [, **Construction Manager**], Architect, and Architect's consultants. Provide **[eight]** <Insert number> hours of software training at Architect's office for web-based Project software users.
  3. At completion of Project, provide digital archive in format that is readable by common desktop software applications in format acceptable to Architect. Provide data in locked format to prevent further changes.
  4. Provide **[one of]** the following web-based Project software packages under their current published licensing agreements:
    - a. Autodesk; **[Buzzsaw]** **[Constructware]**.
    - b. Corecon Technologies, Inc.
    - c. Meridian Systems; Prolog.
    - d. Newforma, Inc.
    - e. Procore Technologies, Inc.
    - f. Viewpoint, Inc.; Viewpoint for Project Collaboration.
    - g. <Insert name of hosting company and product>.
- D. PDF Document Preparation: Where PDFs are required to be submitted to Architect, prepare as follows:



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

## 1.9 PROJECT MEETINGS

- A. General: [**Schedule and conduct**] [**Construction Manager will schedule and conduct**] meetings and conferences at Project site unless otherwise indicated.

1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times a minimum of 10 working days prior to meeting.
2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner[, **Construction Manager,**] and Architect, within [**three**] <Insert number> days of the meeting.

- B. Preconstruction Conference: [**Architect will schedule and conduct**] [**Construction Manager will schedule and conduct**] [**Schedule and conduct**] a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than [**15**] <Insert number> days after execution of the Agreement.

1. Attendees: Authorized representatives of Owner[, **Owner's Commissioning Authority,**] [, **Construction Manager,**] Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
2. Agenda: Discuss items of significance that could affect progress, including the following:
  - a. Responsibilities and personnel assignments.
  - b. Tentative construction schedule.
  - c. Phasing.
  - d. Critical work sequencing and long lead items.
  - e. Designation of key personnel and their duties.
  - f. Lines of communications.
  - g. Use of web-based Project software.
  - h. Procedures for processing field decisions and Change Orders.
  - i. Procedures for RFIs.
  - j. Procedures for testing and inspecting.
  - k. Procedures for processing Applications for Payment.
  - l. Distribution of the Contract Documents.
  - m. Submittal procedures.
  - n. Sustainable design requirements.
  - o. Preparation of Record Documents.
  - p. Use of the premises[ **and existing building**].
  - q. Work restrictions.

- r. Working hours.
  - s. Owner's occupancy requirements.
  - t. Responsibility for temporary facilities and controls.
  - u. Procedures for moisture and mold control.
  - v. Procedures for disruptions and shutdowns.
  - w. Construction waste management and recycling.
  - x. Parking availability.
  - y. Office, work, and storage areas.
  - z. Equipment deliveries and priorities.
  - aa. First aid.
  - bb. Security.
  - cc. Progress cleaning.
3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Sustainable Design Requirements Coordination Conference: [**Owner will schedule and conduct**] [**Construction Manager will schedule and conduct**] a sustainable design coordination conference before starting construction, at a time convenient to Owner[, **Construction Manager**,] Architect, and Contractor.
1. Attendees: Authorized representatives of Owner, [**Owner's Commissioning Authority**,] [**Construction Manager**,] Architect, and their consultants; Contractor and its superintendent and sustainable design coordinator; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect meeting sustainable design requirements, including the following:
    - a. Sustainable design Project checklist.
    - b. General requirements for sustainable design-related procurement and documentation.
    - c. Project closeout requirements and sustainable design certification procedures.
    - d. Role of sustainable design coordinator.
    - e. Construction waste management.
    - f. Construction operations and sustainable design requirements and restrictions.
  3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- D. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity when required by other sections and when required for coordination with other construction.
1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect[, **Construction Manager**] [, and **Owner's Commissioning Authority**] of scheduled meeting dates.
  2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:

- a. Contract Documents.
  - b. Options.
  - c. Related RFIs.
  - d. Related Change Orders.
  - e. Purchases.
  - f. Deliveries.
  - g. Submittals.
  - h. Sustainable design requirements.
  - i. Review of mockups.
  - j. Possible conflicts.
  - k. Compatibility requirements.
  - l. Time schedules.
  - m. Weather limitations.
  - n. Manufacturer's written instructions.
  - o. Warranty requirements.
  - p. Compatibility of materials.
  - q. Acceptability of substrates.
  - r. Temporary facilities and controls.
  - s. Space and access limitations.
  - t. Regulations of authorities having jurisdiction.
  - u. Testing and inspecting requirements.
  - v. Installation procedures.
  - w. Coordination with other work.
  - x. Required performance results.
  - y. Protection of adjacent work.
  - z. Protection of construction and personnel.
3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  5. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- E. Project Closeout Conference: [**Schedule and conduct**] [**Construction Manager will schedule and conduct**] a project closeout conference, at a time convenient to Owner and Architect, but no later than [90] <Insert number> days prior to the scheduled date of Substantial Completion.
1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  2. Attendees: Authorized representatives of Owner, [**Owner's Commissioning Authority,**] [**Construction Manager,**] Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of Record Documents.

- b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
  - c. Procedures for completing and archiving web-based Project software site data files.
  - d. Submittal of written warranties.
  - e. Requirements for completing sustainable design documentation.
  - f. Requirements for preparing operations and maintenance data.
  - g. Requirements for delivery of material samples, attic stock, and spare parts.
  - h. Requirements for demonstration and training.
  - i. Preparation of Contractor's punch list.
  - j. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
  - k. Submittal procedures.
  - l. Coordination of separate contracts.
  - m. Owner's partial occupancy requirements.
  - n. Installation of Owner's furniture, fixtures, and equipment.
  - o. Responsibility for removing temporary facilities and controls.
4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- F. Progress Meetings: [**Conduct**] [**Construction Manager will conduct**] progress meetings at [**weekly**] [**biweekly**] [**monthly**] [**regular**] <Insert appropriate interval> intervals.
1. Coordinate dates of meetings with preparation of payment requests.
  2. Attendees: In addition to representatives of Owner[, **Owner's Commissioning Authority**] [, **Construction Manager,**] and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Resolution of BIM component conflicts.
      - 4) Status of submittals.
      - 5) Status of sustainable design documentation.
      - 6) Deliveries.

- 7) Off-site fabrication.
  - 8) Access.
  - 9) Site use.
  - 10) Temporary facilities and controls.
  - 11) Progress cleaning.
  - 12) Quality and work standards.
  - 13) Status of correction of deficient items.
  - 14) Field observations.
  - 15) Status of RFIs.
  - 16) Status of Proposal Requests.
  - 17) Pending changes.
  - 18) Status of Change Orders.
  - 19) Pending claims and disputes.
  - 20) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.
- G. Coordination Meetings: **[Conduct] [Construction Manager will conduct] [Project Coordinator will conduct]** Project coordination meetings at **[weekly] [biweekly] [monthly] [regular]** <Insert appropriate interval> intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner[, **Owner's Commissioning Authority**] [, **Construction Manager,**] and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
    - b. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:

- 1) Interface requirements.
  - 2) Sequence of operations.
  - 3) Resolution of BIM component conflicts.
  - 4) Status of submittals.
  - 5) Deliveries.
  - 6) Off-site fabrication.
  - 7) Access.
  - 8) Site use.
  - 9) Temporary facilities and controls.
  - 10) Work hours.
  - 11) Hazards and risks.
  - 12) Progress cleaning.
  - 13) Quality and work standards.
  - 14) Status of RFIs.
  - 15) Proposal Requests.
  - 16) Change Orders.
  - 17) Pending changes.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

## SECTION 014000 - QUALITY REQUIREMENTS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and quality-control requirements for individual work results are specified in their respective Specification Sections. Requirements in individual Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and quality-control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and quality-control services required by Architect, Owner, [ **Commissioning Authority**,] [ **Construction Manager**,] or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.
- C. Related Requirements:
  - 1. Section 012100 "Allowances" for testing and inspection allowances.

## 1.3 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced" unless otherwise further described means having successfully completed a minimum of [five] <Insert number> previous projects similar in nature, size, and extent to this Project; being familiar with special

requirements indicated; and having complied with requirements of authorities having jurisdiction.

- B. Field Quality-Control Tests: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- C. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, assembly, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).
- D. Mockups: Full-size physical assemblies that are constructed on-site either as freestanding temporary built elements or as part of permanent construction. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  - 1. Laboratory Mockups: Full-size physical assemblies constructed and tested at testing facility to verify performance characteristics.
  - 2. Integrated Exterior Mockups: Mockups of the exterior envelope constructed on-site as **[freestanding temporary built elements] [or] [as part of permanent construction]**, consisting of multiple products, assemblies, and subassemblies.
  - 3. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes; doors; windows; millwork; casework; specialties; furnishings and equipment; and lighting.
- E. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.
- F. Product Tests: Tests and inspections that are performed by a nationally recognized testing laboratory (NRTL) according to 29 CFR 1910.7, by a testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program (NVLAP), or by a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- G. Source Quality-Control Tests: Tests and inspections that are performed at the source; for example, plant, mill, factory, or shop.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.



- J. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Contractor's quality-control services do not include contract administration activities performed by Architect[ **or Construction Manager**].

#### 1.4 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.

#### 1.5 CONFLICTING REQUIREMENTS

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

#### 1.6 ACTION SUBMITTALS

- A. Shop Drawings: For [**integrated exterior**] [**laboratory**] mockups.
  - 1. Include plans, sections, and elevations, indicating materials and size of mockup construction.
  - 2. Indicate manufacturer and model number of individual components.
  - 3. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.
- B. Delegated-Design Services Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility submitted to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the Statement of Special Inspections.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the Statement of Special Inspections.
- D. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- E. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.
  - 2. Entity responsible for performing tests and inspections.
  - 3. Description of test and inspection.
  - 4. Identification of applicable standards.
  - 5. Identification of test and inspection methods.
  - 6. Number of tests and inspections required.
  - 7. Time schedule or time span for tests and inspections.
  - 8. Requirements for obtaining samples.
  - 9. Unique characteristics of each quality-control service.
- F. Reports: Prepare and submit certified written reports and documents as specified.
- G. Permits, Licenses, and Certificates: For Owner's record, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents established for compliance with standards and regulations bearing on performance of the Work.

## 1.8 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within **[10]** **<Insert number>** days of **[Notice of Award]** **[Notice to Proceed]**, and not less than **[five]** **<Insert number>** days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's Construction Schedule.

- B. Quality-Control Personnel Qualifications: Engage qualified personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
1. Project quality-control manager [**may also serve as Project superintendent**] [**shall not have other Project responsibilities**].
  2. **<Insert qualifications appropriate to Project>**.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
1. Contractor-performed tests and inspections including Subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections. Distinguish source quality-control tests and inspections from field quality-control tests and inspections.
  2. Special inspections required by authorities having jurisdiction and indicated on the Statement of Special Inspections.
  3. Owner-performed tests and inspections indicated in the Contract Documents[, **including tests and inspections indicated to be performed by Commissioning Authority**].
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

## 1.9 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
1. Date of issue.
  2. Project title and number.
  3. Name, address, telephone number, and email address of testing agency.
  4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.

10. Record of temperature and weather conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

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

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

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

1. Name, address, telephone number, and email address of factory-authorized service representative making report.
2. Statement that equipment complies with requirements.
3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
4. Statement whether conditions, products, and installation will affect warranty.
5. Other required items indicated in individual Specification Sections.

#### 1.10 QUALITY ASSURANCE

- A. **General:** Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units. As applicable, procure products from manufacturers able to meet qualification requirements, warranty requirements, and technical or factory-authorized service representative requirements.
- C. **Fabricator Qualifications:** A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. **Installer Qualifications:** A firm or individual experienced in installing, erecting, applying, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. **Professional Engineer Qualifications:** A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar in material, design, and extent to those indicated for this Project.
- F. **Specialists:** Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. **Testing Agency Qualifications:** An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented according to [ASTM E 329] <Insert standard>; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
- H. **Manufacturer's Technical Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. **Factory-Authorized Service Representative Qualifications:** An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. **Preconstruction Testing:** Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens and test assemblies, [and ]mockups[, and laboratory mockups]; do not reuse products on Project.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect[ **and Commissioning Authority**][, **through Construction Manager**], with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.
- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
1. Build mockups of size indicated.
  2. Build mockups in location indicated or, if not indicated, as directed by Architect[ **or Construction Manager**].
  3. Notify Architect[ **and Construction Manager**] [**seven**] **<Insert number>** days in advance of dates and times when mockups will be constructed.
  4. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed to perform same tasks during the construction at Project.
  5. Demonstrate the proposed range of aesthetic effects and workmanship.
  6. Obtain Architect's[ **and Construction Manager's**] approval of mockups before starting corresponding work, fabrication, or construction.
    - a. Allow [**seven**] **<Insert number>** days for initial review and each re-review of each mockup.
  7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  8. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Construct integrated exterior mockup [**according to approved Shop Drawings**] [**as indicated on Drawings**]. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials. Comply with requirements in "Mockups" Paragraph.
- M. Room Mockups: Construct room mockups [**according to approved Shop Drawings**] [**as indicated on Drawings**] incorporating required materials and assemblies, finished according to requirements. Provide required lighting and additional lighting where required to enable Architect to evaluate quality of the Work. Comply with requirements in "Mockups" Paragraph.
- N. Provide room mockups of the following rooms:
1. **<Insert room name or description>**.
- O. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
- 1.11 QUALITY CONTROL
- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspection they are engaged to perform.
  2. Payment for these services will be made from testing and inspection allowances, as authorized by Change Orders.
  3. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor[, **and the Contract Sum will be adjusted by Change Order**].
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities, whether specified or not, to verify and document that the Work complies with requirements.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  2. Engage a qualified testing agency to perform quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  3. Notify testing agencies at least [24] <Insert number> hours in advance of time when Work that requires testing or inspection will be performed.
  4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Architect[, **Commissioning Authority**] [, **Construction Manager**,] and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Architect[, **Commissioning Authority**,] [, **Construction Manager**,] and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  2. Determine the locations from which test samples will be taken and in which in-situ tests are conducted.
  3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  6. Do not perform duties of Contractor.

- E. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 013300 "Submittal Procedures."
- F. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in preinstallation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- G. **Associated Contractor Services:** Cooperate with agencies and representatives performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
  2. Incidental labor and facilities necessary to facilitate tests and inspections.
  3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
  4. Facilities for storage and field curing of test samples.
  5. Delivery of samples to testing agencies.
  6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  7. Security and protection for samples and for testing and inspection equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents[ **as a component of Contractor's quality-control plan**]. Coordinate and submit concurrently with Contractor's Construction Schedule. Update as the Work progresses.
1. **Distribution:** Distribute schedule to Owner, Architect,[ **Commissioning Authority,**] [ **Construction Manager,**] testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.12 SPECIAL TESTS AND INSPECTIONS

- A. **Special Tests and Inspections:** [ **Owner will engage**] [ **Engage**] a qualified [ **testing agency**] [ **special inspector**] to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner[, **as indicated in the Statement of Special Inspections attached to this Section**], and as follows:



1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect[, **Commissioning Authority,**] [, **Construction Manager,**] and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect[ **and Commissioning Authority**][, **through Construction Manager,**] with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected work.
  7. **<Insert requirements>.**
- B. Special Tests and Inspections: Conducted by a qualified [**testing agency**] [**special inspector**] as required by authorities having jurisdiction, as indicated in individual Specification Sections[ **and in the Statement of Special Inspections attached to this Section**], and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect[, **Commissioning Authority,**] [, **Construction Manager,**] and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect[ **and Commissioning Authority**][, **through Construction Manager,**] with copy to Contractor and to authorities having jurisdiction.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting corrected work.
  7. **<Insert requirements>.**

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 ACCEPTABLE TESTING AGENCIES

- A. **<Insert list of firms acceptable to perform designated tests and inspections>.**

### 3.2 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's[, **Commissioning Authority's**,][ **and Construction Manager's**] reference during normal working hours.
1. Submit log at Project closeout as part of Project Record Documents.

### 3.3 REPAIR AND PROTECTION

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

END OF SECTION 014000

## SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
  - 2. Section 011200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.
  - 3. Section 312319 "Dewatering" for disposal of ground water at Project site.

## 1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, [ **Owner's construction forces,**] Architect, [ **occupants of Project,**] testing agencies, and authorities having jurisdiction.
- B. Sewer Service: [ **Pay**] [ **Owner will pay**] sewer-service use charges for sewer usage by all entities for construction operations.
- C. Water Service: [ **Pay**] [ **Owner will pay**] water-service use charges for water used by all entities for construction operations.
- D. Electric Power Service: [ **Pay**] [ **Owner will pay**] electric-power-service use charges for electricity used by all entities for construction operations.

- E. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- F. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- G. Sewer, Water, and Electric Power Service: Use charges are specified in Section 011200 "Multiple Contract Summary."

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within [15] <Insert number> days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. [<Double click to insert sustainable design text for erosion- and sedimentation-control plan.>](#)
- E. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- F. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold.
- G. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
  - 1. Locations of dust-control partitions at each phase of work.
  - 2. HVAC system isolation schematic drawing.
  - 3. Location of proposed air-filtration system discharge.
  - 4. Waste-handling procedures.
  - 5. Other dust-control measures.

#### 1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

- C. Accessible Temporary Egress: Comply with applicable provisions in [**the United States Access Board's ADA-ABA Accessibility Guidelines**] [**and**] [**ICC/ANSI A117.1**].

## 1.6 PROJECT CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Chain-Link Fencing: Minimum **2-inch (50-mm)**, **0.148-inch- (3.8-mm-)** thick, galvanized-steel, chain-link fabric fencing; minimum **6 feet (1.8 m)** high with galvanized-steel pipe posts; minimum **2-3/8-inch- (60-mm-)** OD line posts and **2-7/8-inch- (73-mm-)** OD corner and pull posts[, **with 1-5/8-inch- (42-mm-) OD top rails**] [, **with galvanized barbed-wire top strand**].
- B. Portable Chain-Link Fencing: Minimum **2-inch (50-mm)**, **0.148-inch- (3.8-mm-)** thick, galvanized-steel, chain-link fabric fencing; minimum **6 feet (1.8 m)** high with galvanized-steel pipe posts; minimum **2-3/8-inch- (60-mm-)** OD line posts and **2-7/8-inch- (73-mm-)** OD corner and pull posts, with **1-5/8-inch- (42-mm-)** OD top and bottom rails. Provide [**concrete**] [**galvanized-steel**] bases for supporting posts.
- C. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.
- D. Wood Enclosure Fence: Plywood, [**6 feet (1.8 m)**] [**8 feet (2.4 m)**] high, framed with four **2-by-4-inch (50-by-100-mm)** rails, with preservative-treated wood posts spaced not more than **8 feet (2.4 m)** apart.
- E. Polyethylene Sheet: Reinforced, fire-resistive sheet, **10-mil (0.25-mm)** minimum thickness, with flame-spread rating of 15 or less per ASTM E 84 and passing NFPA 701 Test Method 2.
- F. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats minimum **36 by 60 inches (914 by 1524 mm)**.
- G. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

### 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

- B. Field Offices, General: Owner will provide conditioned interior space for field offices [**for duration of Project**] [**upon completion of demolition and enclosure**].
- C. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect[, **Construction Manager**], and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Conference room of sufficient size to accommodate meetings of [**10**] <Insert number> individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and **4-foot- (1.2-m-)** square tack and marker boards.
  - 3. Drinking water and private toilet.
  - 4. Heating and cooling equipment necessary to maintain a uniform indoor temperature of **68 to 72 deg F (20 to 22 deg C)**.
  - 5. Lighting fixtures capable of maintaining average illumination of **20 fc (215 lx)** at desk height.
- D. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of [**8**] <Insert number> at each return-air grille in system and remove at end of construction[.][ **and clean HVAC system as required in Section 017700 "Closeout Procedures."**]
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

## PART 3 - EXECUTION

## 3.1 TEMPORARY FACILITIES, GENERAL

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

## 3.2 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
  - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

## 3.3 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to **[municipal system]** **[private system indicated]** as directed by authorities having jurisdiction.
- C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
- D. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  - 1. Toilets: Use of Owner's existing toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

- F. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- G. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
1. Prior to commencing work, isolate the HVAC system in area where work is to be performed[ **according to coordination drawings**].
    - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
  2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
  3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- H. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
1. Install electric power service [**overhead**] [**underground**] unless otherwise indicated.
  2. Connect temporary service to Owner's existing power source, as directed by Owner.
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- K. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install [**WiFi cell phone access equipment**] [**and**] [**one**] <Insert number> land-based telephone line(s) for each field office.
1. Provide additional telephone lines for the following:
    - a. Provide [**one**] <Insert number> telephone line(s) for Owner's use.
  2. At each telephone, post a list of important telephone numbers.



- a. Police and fire departments.
  - b. Ambulance service.
  - c. Contractor's home office.
  - d. Contractor's emergency after-hours telephone number.
  - e. Architect's office.
  - f. **[Construction Manager's home office.]**
  - g. Engineers' offices.
  - h. Owner's office.
  - i. Principal subcontractors' field and home offices.
- L. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
1. Processor: Intel Core i5 or i7.
  2. Memory: [4] <Insert number> gigabyte.
  3. Disk Storage: [500] <Insert number> gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
  4. Display: 24-inch (610-mm) LCD monitor with 256-Mb dedicated video RAM.
  5. Full-size keyboard and mouse.
  6. Network Connectivity: [10/100BaseT Ethernet] [Gigabit].
  7. Operating System: Microsoft Windows 7 Professional.
  8. Productivity Software:
    - a. Microsoft Office Professional, 2010 or higher, including Word, Excel, and Outlook.
    - b. Adobe Reader 11.0 or higher.
    - c. WinZip 7.0 or higher.
  9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
  10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum [1.0] <Insert number> Mbps upload and [15] <Insert number> Mbps download speeds at each computer.
  11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
  12. Backup: External hard drive, minimum [2] <Insert number> terrabyte, with automated backup software providing daily backups.

### 3.4 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas [**as indicated**] [**within construction limits indicated**] on Drawings.
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.
- C. Temporary Use of Planned Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  2. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Section 312000 "Earth Moving."
  3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  4. Delay installation of final course of permanent hot-mix asphalt pavement until immediately before Substantial Completion. Repair hot-mix asphalt base-course pavement before installation of final course according to Section 321216 "Asphalt Paving."
- D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- E. Parking: [**Provide temporary**] [**Use designated areas of Owner's existing**] parking areas for construction personnel.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  2. Remove snow and ice as required to minimize accumulations.
- G. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
1. Identification Signs: Provide Project identification signs as indicated on Drawings.
  2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
    - a. Provide temporary, directional signs for construction personnel and visitors.
  3. Maintain and touch up signs so they are legible at all times.
- H. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

- I. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- J. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- K. Temporary Elevator Use: **[Use of elevators is not permitted.] [See] [Section 142100 "Electric Traction Elevators"] [Section 142113 "Electric Traction Freight Elevators"] [Section 142123.16 "Machine Room-Less Electric Traction Passenger Elevators"] [Section 142400 "Hydraulic Elevators"] [Section 142413 "Hydraulic Freight Elevators"] [Section 142600 "Limited-Use/Limited-Application Elevators"] [for temporary use of new elevators].**
- L. Existing Elevator Use: Use of Owner's existing elevators will be permitted, provided elevators are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore elevators to condition existing before initial use, including replacing worn cables, guide shoes, and similar items of limited life.
  - 1. Do not load elevators beyond their rated weight capacity.
  - 2. Provide protective coverings, barriers, devices, signs, or other procedures to protect elevator car and entrance doors and frame. If, despite such protection, elevators become damaged, engage elevator Installer to restore damaged work so no evidence remains of correction work. Return items that cannot be refinished in field to the shop, make required repairs and refinish entire unit, or provide new units as required.
- M. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
- N. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.
  - 1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.
- O. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
  1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: Comply with **[requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and]** requirements specified in Section 311000 "Site Clearing."
- D. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to **[erosion- and sedimentation-control Drawings] [requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent]**.
  1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
  2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
  3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
  4. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.
- E. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- F. Tree and Plant Protection: Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
- G. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- H. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using materials approved by authorities having jurisdiction.
- I. Site Enclosure Fence: **[Before construction operations begin] [Prior to commencing earthwork]**, furnish and install site enclosure fence in a manner that will prevent people from easily entering site except by entrance gates.

1. Extent of Fence: [**As required to enclose entire Project site or portion determined sufficient to accommodate construction operations**] [**As indicated on Drawings**].
  2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. [**Furnish one set of keys to Owner.**]
- J. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each workday.
- K. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- L. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- M. Covered Walkway: Erect protective, covered walkway for passage of individuals through or adjacent to Project site. Coordinate with entrance gates, other facilities, and obstructions. Comply with regulations of authorities having jurisdiction [**and requirements indicated on Drawings**].
1. Provide overhead decking, protective enclosure walls, handrails, barricades, warning signs, exit signs, lights, safe and well-drained walkways, and similar provisions for protection and safe passage.
  2. Paint and maintain appearance of walkway for duration of the Work.
- N. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
- O. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by [**Owner**] [**and**] [**tenants**] from fumes and noise.
1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.
  2. Construct dustproof partitions with two layers of 6-mil (0.14-mm) polyethylene sheet on each side. Cover floor with two layers of 6-mil (0.14-mm) polyethylene sheet, extending sheets 18 inches (460 mm) up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.
    - a. Construct vestibule and airlock at each entrance through temporary partition with not less than 48 inches (1219 mm) between doors. Maintain water-dampened foot mats in vestibule.
  3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.
  4. Insulate partitions to control noise transmission to occupied areas.
  5. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.

6. Protect air-handling equipment.
  7. Provide walk-off mats at each entrance through temporary partition.
- P. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
1. Prohibit smoking in construction areas. Comply with additional limits on smoking specified in other Sections.
  2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
  4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 3.6 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
  3. Indicate methods to be used to avoid trapping water in finished work.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.

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

### 3.7 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
  2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove

materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.

3. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000



## SECTION 015639 - TEMPORARY TREE AND PLANT PROTECTION

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 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 "Site Clearing" for removing existing trees and shrubs.

## 1.3 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by **[a diameter tape] [or] [the average of the smallest and largest diameters]** at a height 6 inches (150 mm) above the ground for trees up to and including 4-inch (100-mm) size at this height and as measured at a height of 12 inches (300 mm) above the ground for trees larger than 4-inch (100-mm) size.
- B. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by **[a diameter tape] [or] [the average of the smallest and largest diameters]** at a height 54 inches (1372 mm) above the ground line **[for trees with caliper of 8 inches (200 mm) or greater as measured at a height of 12 inches (300 mm) above the ground]**.
- C. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- D. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and **[indicated on Drawings] [defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated] [defined by a circle concentric with each tree with a radius 12 times the tree's caliper size]**

**and with a minimum radius of 96 inches (2400 mm) unless otherwise indicated] <Insert requirement>.**

- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] <Insert location>.
1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
    - a. Tree-service firm's personnel, and equipment needed to make progress and avoid delays.
    - b. Arborist's responsibilities.
    - c. Quality-control program.
    - d. Coordination of Work and equipment movement with the locations of protection zones.
    - e. Trenching by hand or with air spade within protection zones.
    - f. Field quality control.
    - g. <Insert agenda items>.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
1. Include plans, elevations, sections, and locations of protection-zone fencing and signage, showing relation of equipment-movement routes and material storage locations with protection zones.
  2. Detail fabrication and assembly of protection-zone fencing and signage.
  3. Indicate extent of trenching by hand or with air spade within protection zones.
- C. Samples: For each type of the following:
1. Organic Mulch: [**1-pint (0.5-L)**] [**1-quart (1-L)**] <Insert value> volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
  2. Protection-Zone Fencing: Assembled Samples of [**manufacturer's standard size made from full-size components**] <Insert dimensions>.
  3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- D. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
1. Species and size of tree.
  2. Location on site plan. Include unique identifier for each.
  3. Reason for pruning.

4. Description of pruning to be performed.
5. Description of maintenance following pruning.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- C. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- D. 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.
- E. Quality-control program.

#### 1.7 QUALITY ASSURANCE

- A. Arborist Qualifications: [**Certified Arborist as certified by ISA**] [**Certified Arborist-Municipal Specialist as certified by ISA**] [**Licensed arborist in jurisdiction where Project is located**] [**Current member of ASCA**] [**Registered Consulting Arborist as designated by ASCA**] <Insert requirement>.
- B. Tree Service Firm Qualifications: An 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.
- C. Quality-Control Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work without damaging trees and plantings. Include dimensioned diagrams for placement of protection zone fencing and signage, the arborist's and tree-service firm's responsibilities, instructions given to workers on the use and care of protection zones, and enforcement of requirements for protection zones.

#### 1.8 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. Foot traffic.

4. Erection of sheds or structures.
  5. Impoundment of water.
  6. Excavation or other digging unless otherwise indicated.
  7. 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. Backfill Soil: **[Stockpiled soil from location shown on Drawings] [Stockpiled soil mixed with planting soil] [Planting soil]** of suitable moisture content and granular texture for placing around tree; free of stones, roots, plants, sod, clods, clay lumps, pockets of coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth.
1. Mixture: Well-blended mix of **[two parts stockpiled soil to one part planting soil] <Insert requirement>**.
  2. Planting Soil: Planting soil **<Insert drawing designation>** as specified in **[Section 329113 "Soil Preparation"] [Section 329115 "Soil Preparation (Performance Specification)."]**
- B. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
1. Type: **[Shredded hardwood] [Ground or shredded bark] [Wood and bark chips] <Insert mulch type>**.
  2. Size Range: **[3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum] <Insert size range>**.
  3. Color: Natural.
- C. Protection-Zone Fencing: Fencing fixed in position and meeting **[one of]** the following requirements: **[ Previously used materials may be used when approved by Architect.]**
1. Chain-Link Protection-Zone Fencing: **[Galvanized-steel] [Polymer-coated steel] [Polymer-coated galvanized-steel]** fencing fabricated from minimum 2-inch (50-mm) opening, 0.148-inch- (3.76-mm-) diameter wire chain-link fabric; with pipe posts, minimum 2-3/8-inch- (60-mm-) OD line posts, and 2-7/8-inch- (73-mm-) OD corner and pull posts **[/b> **with 1-5/8-inch- (42-mm-) OD top rails] [; with 0.177-inch- (4.5-mm-) diameter top tension wire]** and 0.177-inch- (4.5-mm-) diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
    - a. Height: **[48 inches (1200 mm)] [72 inches (1800 mm)] [96 inches (2400 mm)] <Insert dimension>**.**

- b. Polymer-Coating Color: **[Dark green] [Olive green] [Brown] [Black]** <Insert color>.
2. Plywood Protection-Zone Fencing: Plywood framed with four 2-by-4-inch (50-by-100-mm) rails, with **[4-by-4-inch (100-by-100-mm)]** <Insert dimensions> preservative-treated wood posts spaced not more than 96 inches (2400 mm) apart.
    - a. Height: **[48 inches (1200 mm)] [72 inches (1800 mm)]** <Insert dimension>.
    - b. Plywood and Lumber: Comply with requirements in **[Section 061000 "Rough Carpentry."]** **[Section 061053 "Miscellaneous Rough Carpentry."]**
  3. Wood Protection-Zone Fencing: Constructed of two 2-by-4-inch (50-by-100-mm) horizontal rails, with **[4-by-4-inch (100-by-100-mm)]** <Insert dimensions> preservative-treated wood posts spaced not more than 96 inches (2400 mm) apart, and lower rail set halfway between top rail and ground.
    - a. Height: **[48 inches (1200 mm)]** <Insert dimension>.
    - b. Lumber: Comply with requirements in **[Section 061000 "Rough Carpentry."]** **[Section 061053 "Miscellaneous Rough Carpentry."]**
  4. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); 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 (2400 mm) apart.
    - a. Height: **[48 inches (1200 mm)]** <Insert dimension>.
    - b. Color: High-visibility orange, nonfading.
  5. Gates: **[Single-] [Double-]** swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width **[24 inches (610 mm)] [36 inches (914 mm)] [As indicated]** <Insert width>.
- D. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes prepunched and reinforced; legibly printed with nonfading lettering and as follows:
1. Size and Text: **[As shown on Drawings]** <Insert requirement>.
  2. Lettering: **[3-inch- (75-mm-)]** <Insert dimension> high minimum, **[white] [black]** <Insert color> characters on **[white] [red]** <Insert color> background.

## 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[ **or to be relocated**]. [**Flag**] [**Tie a 1-inch (25-mm) blue vinyl tape around**] <Insert requirement> each tree trunk at 54 inches (1372 mm) above the ground.
- 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 [**2-inch (50-mm)**] [**4-inch (100-mm)**] <Insert dimension> uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within [**6 inches (150 mm)**] <Insert dimension> 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**] <Insert requirement> in a manner that will prevent people[ **and animals**] 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. Chain-Link Fencing: Install to comply with ASTM F 567 and with manufacturer's written instructions.
  - 2. 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.
  - 3. Access Gates: Install[ **where indicated**] <Insert requirement>; 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 [20 feet (6 m)] [35 feet (10.5 m)] [50 feet (15 m)] <Insert dimension> on protection-zone fencing, but no fewer than [four] <Insert number> 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. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
  - 2. 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 312000 "Earth Moving" 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 (75 mm) 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 shown on Drawings][.] [and] [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] [Coat cut ends of roots more than 1-1/2 inches (38 mm) in diameter with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to arborist] <Insert requirement>**.
  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 **[12 inches (300 mm) outside] [12 inches (300 mm) inside] [6 inches (150 mm) outside] [6 inches (150 mm) inside] [flush with the edge] <Insert requirement>** 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 shown on Drawings, under direction of arborist] [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]**.
    - a. Type of Pruning: **[Cleaning] [raising] [reducing] [and] [thinning]** where indicated.
    - b. Specialty Pruning: **[Structural] [restoration] [vista] [espalier] [pollarding] [palm] [and] [utility]** where indicated.
- B. Unless otherwise directed by arborist and acceptable to Architect, 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 **[spread over areas identified by Architect] [stockpile in areas approved by Architect] [dispose of off-site] <Insert requirement>**.



### 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 (50 mm)**] <Insert dimension> 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 [**25**] [**66**] <Insert number> percent dead or in an unhealthy condition[ **before the end of the corrections period**] or are damaged during construction operations that Architect 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 [**6 inches (150 mm)**] [**4 inches (100 mm)**] <Insert dimension> or smaller in caliper size.
  - 2. Large Trees: Provide [**one**] [**two**] <Insert number> new tree(s) of [**6-inch (150-mm)**] [**4-inch (100-mm)**] <Insert dimension> caliper size for each tree being replaced that measures more than [**6 inches (150 mm)**] [**4 inches (100 mm)**] in caliper size.
    - a. Species: [**As selected by Architect**] <Insert species>.
  - 3. Plant and maintain new trees as specified in Section 329300 "Plants."

- C. Excess Mulch: Rake mulched area within protection zones, being careful not to injure roots. Rake to loosen and remove mulch that exceeds a [2-inch (50-mm)] [4-inch (100-mm)] <Insert dimension> uniform thickness to remain.
- D. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate [10 feet (3 m)] <Insert dimension> beyond drip line and no closer than [36 inches (900 mm)] <Insert dimension> to tree trunk. Drill [2-inch- (50-mm-)] <Insert dimension> diameter holes a minimum of 12 inches (300 mm) deep at [24 inches (600 mm)] <Insert dimension> 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 015639

## SECTION 017839 - PROJECT RECORD DOCUMENTS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 011200 "Multiple Contract Summary" for coordinating project record documents covering the Work of multiple contracts.
  - 2. Section 017300 "Execution" for final property survey.
  - 3. Section 017700 "Closeout Procedures" for general closeout procedures.
  - 4. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

## 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit [**one**] <**Insert number**> set(s) of marked-up record prints.
  - 2. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:

- 1) Submit [**one**] <Insert number> paper-copy set(s) of marked-up record prints.
  - 2) Submit PDF electronic files of scanned record prints and [**one**] <Insert number> of file prints.
  - 3) Submit record digital data files and [**one**] <Insert number> set(s) of plots.
  - 4) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
- b. Final Submittal:
- 1) Submit [**three**] <Insert number> paper-copy set(s) of marked-up record prints.
  - 2) Submit PDF electronic files of scanned record prints and [**three**] <Insert number> set(s) of prints.
  - 3) Print each drawing, whether or not changes and additional information were recorded.
- c. Final Submittal:
- 1) Submit [**one**] <Insert number> paper-copy set(s) of marked-up record prints.
  - 2) Submit record digital data files and [**three**] <Insert number> set(s) of record digital data file plots.
  - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit [**one paper copy**] [<Insert number> **paper copies**] [**annotated PDF electronic files**] of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit [**one paper copy**] [<Insert number> **paper copies**] [**annotated PDF electronic files and directories**] of each submittal.
1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit [**one paper copy**] [<Insert number> **paper copies**] [**annotated PDF electronic files and directories**] of each submittal.
- E. Reports: Submit written report [**weekly**] indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.
- 1.4 RECORD DRAWINGS
- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding photographic documentation.
  2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.
    - c. Depths of foundations.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or [**Construction**] [**Work**] Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect[ **and Construction Manager**]. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
  2. Format: [**DWG**] [**DXF**] [**DGN**], Version <Insert designation>, [**Microsoft Windows**] [**Apple Macintosh**] operating system.
  3. Format: Annotated PDF electronic file[ **with comment function enabled**].
  4. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.

5. Refer instances of uncertainty to Architect[ **through Construction Manager**] for resolution.
  6. Architect will furnish Contractor with one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Section 013100 "Project Management and Coordination" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
  2. Format: Annotated PDF electronic file[ **with comment function enabled**].
  3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
  4. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect[ **and Construction Manager**].
    - e. Name of Contractor.

## 1.5 RECORD SPECIFICATIONS

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

## 1.6 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders[, **record Specifications,**] and record Drawings where applicable.
- C. Format: Submit record Product Data as [**annotated PDF electronic file**] [**paper copy**] [**scanned PDF electronic file(s) of marked-up paper copy of Product Data**].
  - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

## 1.7 MISCELLANEOUS RECORD SUBMITTALS

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

## 1.8 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's[ **and Construction Manager's**] reference during normal working hours.

## PART 2 - PRODUCTS

## PART 3 - EXECUTION

END OF SECTION 017839

## SECTION 024119 - SELECTIVE DEMOLITION

**TIPS:**

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To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

## B. Related Requirements:

1. Section 011000 "Summary" for restrictions on use of the premises, Owner-occupancy requirements, and phasing requirements.
2. Section 015639 "Temporary Tree and Plant Protection" for temporary protection of existing trees and plants that are affected by selective demolition.
3. Section 017300 "Execution" for cutting and patching procedures.
4. Section 013516 "Alteration Project Procedures" for general protection and work procedures for alteration projects.
5. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

## 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and **[deliver to Owner ready for reuse] [store]**.



- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

#### 1.4 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  - 1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

#### 1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at **[Project site]** **<Insert location>**.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Engineering Survey: Submit engineering survey of condition of building.
- C. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property **[, for environmental protection]** **[, for dust control]** **[and]** **[, for noise control]**. Indicate proposed locations and construction of barriers.
- D. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's **[building manager's]** **[and]** **[other tenants']** on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.

3. Coordination for shutoff, capping, and continuation of utility services.
  4. Use of elevator and stairs.
  5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- E. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

#### 1.7 CLOSEOUT SUBMITTALS

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

#### 1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

#### 1.9 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
1. Before selective demolition, Owner will remove the following items:
    - a. **<Insert items to be removed by Owner>**.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
1. Hazardous materials will be removed by Owner before start of the Work.
  2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

- E. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
  - 1. Hazardous material remediation is specified elsewhere in the Contract Documents.
  - 2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  - 3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- F. Historic Areas: Demolition and hauling equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, including temporary protection, by [**12 inches (300 mm)**] <Insert dimension> or more.
- G. Storage or sale of removed items or materials on-site is not permitted.
- H. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

#### 1.10 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials and using approved contractors so as not to void existing warranties. Notify warrantor before proceeding. Existing warranties include the following:
  - 1. <Insert warranted system>.
- B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

#### 1.11 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

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

- C. [<Double click to insert sustainable design text for building reuse.>](#)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. **[Perform] [Engage a professional engineer to perform]** an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- D. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- E. Verify that hazardous materials have been remediated before proceeding with building demolition operations.
- F. Survey of Existing Conditions: Record existing conditions by use of **[measured drawings] [preconstruction photographs or video] [and] [templates]**.
1. Comply with requirements specified in Section 013233 "Photographic Documentation."
  2. Inventory and record the condition of items to be removed and salvaged. Provide photographs or video of conditions that might be misconstrued as damage caused by salvage operations.
  3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. Owner will arrange to shut off indicated services/systems when requested by Contractor.
  2. Arrange to shut off utilities with utility companies.
  3. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  4. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated on Drawings to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material and leave in place.
    - c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
    - e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
    - f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
    - g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material and leave in place.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  - 1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  - 2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  - 3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  - 4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  - 5. Maintain fire watch during and for at least **<Insert number>** hours after flame-cutting operations.
  - 6. Maintain adequate ventilation when using cutting torches.
  - 7. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  - 8. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  - 9. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  - 10. Dispose of demolished items and materials promptly. [**Comply with requirements in Section 017419 "Construction Waste Management and Disposal."**]
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- C. Work in Historic Areas: Selective demolition may be performed only in areas of Project that are not designated as historic. In historic spaces, areas, and rooms, or on historic surfaces, the terms "demolish" or "remove" shall mean historic "removal" or "dismantling" as specified in Section 024296 "Historic Removal and Dismantling."
- D. Removed and Salvaged Items:
  - 1. Clean salvaged items.
  - 2. Pack or crate items after cleaning. Identify contents of containers.
  - 3. Store items in a secure area until delivery to Owner.
  - 4. Transport items to Owner's storage area [**on-site**] [**off-site**] [**designated by Owner**] [**indicated on Drawings**].
  - 5. Protect items from damage during transport and storage.

- E. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- F. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition[ **and cleaned**] and reinstalled in their original locations after selective demolition operations are complete.

### 3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least **3/4 inch (19 mm)** at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, and then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." [ **Do not use methods requiring solvent-based adhesive strippers.**]
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Section **<Insert Section number and title>** for new roofing requirements.
1. Remove existing roof membrane, flashings, copings, and roof accessories.
  2. Remove existing roofing system down to substrate.

### 3.7 DISPOSAL OF DEMOLISHED MATERIALS

- A. Remove demolition waste materials from Project site [**and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.**] [**and recycle or dispose of them according to Section 017419 "Construction Waste Management and Disposal."**]
1. Do not allow demolished materials to accumulate on-site.

2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

### 3.8 CLEANING

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

### 3.9 SELECTIVE DEMOLITION SCHEDULE

- A. Remove: **<Insert description of items and construction to remove>**.
- B. Remove and Salvage: **<Insert description of items to remove and salvage>**.
- C. Remove and Reinstall: **<Insert description of items to remove and reinstall>**.
- D. Existing to Remain: **<Insert description of items to remain>**.
- E. Dismantle: **<Insert description of items to be removed>**.

END OF SECTION 024119



## SECTION 134713 - CATHODIC PROTECTION

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 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 passive cathodic protection systems that use [**magnesium**] [**zinc**] anodes to protect [**iron and steel piping**] [**and**] [**tanks**].

## 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design, supervise, test, and inspect the installation of cathodic protection systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 1. Design cathodic protection for pipelines according to NACE RP0169.
  - 2. Design cathodic protection for metal underground storage tanks according to NACE RP0285.
- B. Survey site and determine soil or water corrosivity (resistivity), current requirements, potential surveys, stray currents, and water chemistry/corrosivity (pH).
- C. Select anodes and accessories relevant to level of protection. Design anodes for an estimated life of [**15**] [**30**] years before replacement.
- D. Cathodic protection systems shall provide protective potential that complies with referenced NACE standards. Insulators are required if needed to insulate protected metals from other structures.

## 1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: For cathodic protection. Include plans, evaluations, sections, details, and attachments to other work.
  - 1. Detail locations of cathodic protection equipment, devices, and outlets, with characteristics and cross-references to products.
  - 2. Include calculations and details of anode designs.
  - 3. Include labeling and identifying scheme for wires, cables, and test boxes.
- C. Delegated-Design Submittal: For cathodic protection system indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified corrosion engineer responsible for their preparation.
  - 1. Conduct site tests necessary for design, including soil resistivity, close-interval potential surveys, testing during construction, interference testing, and training of Owner's personnel.
  - 2. Provide system design calculations, stating the maximum recommended anode current output density, and the rate of gaseous production, if any, at that current density.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, and coordinating connections to **[piping]** **[and]** **[tanks]**.
- B. Qualification Data: For qualified professional engineer. Submit evidence of current license, corporate authorization (if applicable) of the engineering business, and NACE certifications.
- C. Field quality-control reports.
- D. Warranty: Sample of special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Basic system operation, outlining the step-by-step procedures required for system startup, operation, adjustment of current flow, and shutdown.
  - 2. Instructions for pipe-to-reference cell and tank-to-reference cell potential measurements and frequency of monitoring.
  - 3. Instructions for dielectric connections, interference and sacrificial-anode bonds; and precautions to ensure safe conditions during repair of pipe, tank or other metallic systems. Instructions shall be neatly bound.
  - 4. Locations of all anodes, test stations, and insulating joints.
  - 5. Structure-to-reference cell potentials as measured during the tests required by "Field Quality Control" Article.
  - 6. Recommendations for maintenance testing, including instructions for pipe-to-reference cell potential measurements and frequency of testing.
  - 7. Precautions to ensure safe conditions during repair of pipe system.

## 1.7 QUALITY ASSURANCE

- A. Corrosion Engineer Qualifications: A qualified professional engineer who has education and experience in cathodic protection of buried and submerged metal structures and has NACE accreditation or certification as a Corrosion Specialist or Cathodic Protection Specialist.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect anodes from exposure to rain and direct sunlight.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace permanent reference electrodes that fail in materials or workmanship within specified warranty period.

1. Warranty Period: [15] [30]<Insert number> years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MAGNESIUM ANODES, TYPE II

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Comply with ASTM B 843.
- C. Chemical composition as percent of weight shall be as follows:
  1. Aluminum: 0.010 maximum.
  2. Manganese: 0.50 to 1.3.
  3. Zinc: 0.05 maximum.
  4. Silicon: 0.50 maximum.
  5. Copper: 0.02 maximum.
  6. Nickel: 0.001 maximum.
  7. Iron: 0.03 maximum.
  8. Other Impurities: 0.05 each; 0.3 maximum total.
  9. Magnesium: Remainder.
- D. Anode Core: Galvanized steel with anode wire silver-soldered to the core. Connection shall be recessed and epoxy insulated for 600-V rating. Connection shall be covered with heat-shrinkable tubing, and insulation shall be extended over connection.
- E. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation according to ASTM D 1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.

- F. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes shall be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material shall have the following chemical composition by weight:
1. Hydrated Gypsum: 75 percent.
  2. Bentonite Clay: 20 percent.
  3. Anhydrous Sodium Sulfate: 5 percent.

## 2.2 MAGNESIUM/MANGANESE ALLOY ANODES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Chemical composition as percent of weight shall be as follows:
1. Aluminum: 0.01 maximum.
  2. Manganese: 0.50 to 1.3.
  3. Copper: 0.02 maximum.
  4. Nickel: 0.001 maximum.
  5. Iron: 0.03 maximum.
  6. Other Impurities: 0.05 each; 0.3 maximum total.
  7. Magnesium: Remainder.
- C. Bare Anode Weight: **40 lb (18 kg)**, not including core, and a nominal length of **60 inches (1520 mm)**.
- D. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation according to ASTM D 1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
- E. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes shall be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material shall have the following chemical composition by weight:
1. Hydrated Gypsum: 75 percent.
  2. Bentonite Clay: 20 percent.
  3. Anhydrous Sodium Sulfate: 5 percent.

## 2.3 ZINC ANODES FOR BURIED SERVICE, TYPE Z-1

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Comply with ASTM B 418, Type II.
- C. Chemical composition as percent of weight shall be as follows:

1. Aluminum: 0.005 maximum.
  2. Cadmium: 0.003 maximum.
  3. Iron: 0.0014 maximum.
  4. Zinc: Remainder.
- D. Bare Anode Ingot Weight: **30 lb (13.6 kg)**, **2 inches (50 mm)** square and **30 inches (760 mm)** long. Packaged weight of anode bag shall be **70 lb (32 kg)**.
- E. Anode Wires: Factory-installed cables, with copper conductors, suitable for direct burial; not less than No. 10 AWG with Type THWN insulation according to ASTM D 1248 and NEMA WC 70/ICEA S-95-658; long enough to extend to accompanying junction box without splicing.
- F. Anode Backfill: Backfill materials packaged in water-permeable fabric sack or cardboard container. Anodes shall be factory installed in packaged backfill using methods that result in dense packing of fill with factory-installed anode spacers to ensure centering of anode in packaged anode backfill. Backfill material shall have the following chemical composition by weight:
1. Hydrated Gypsum: 75 percent.
  2. Bentonite Clay: 20 percent.
  3. Anhydrous Sodium Sulfate: 5 percent.

## 2.4 PERMANENT REFERENCE ELECTRODES

- A. [**Copper/copper sulfate (Cu/CuSO<sub>4</sub>)**] <Insert type>, suitable for direct burial. Electrode shall be guaranteed by supplier for [15] [30] <Insert number> years' service in the installed environment.

## 2.5 WIRE AND CABLE

- A. Anode Header Cable: Single-conductor, Type HMWPE, insulated cable specifically designed for direct-buried dc service in cathodic protection installations.
1. Conductor: Stranded, annealed, uncoated copper, not less than No. 8 AWG, complying with ASTM B 3 and ASTM B 8.
  2. Insulation: High-molecular-weight polyethylene, complying with NEMA WC 70/ICEA S-95-658.
  3. Minimum Average Thickness of Insulation: **110 mils (2.8 mm)** for Nos. 8 through 2 AWG, and **125 mils (3.2 mm)** for Nos. 1 through 4/0 AWG; rated at 600 V.
  4. Connectors: [**Copper-compression type**] [or] [**exothermic welds**].
- B. Conductors and Cables: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Bonding Conductors for Joint and Continuity Bonds: Not less than No. 8 AWG, stranded, Type THWN copper conductors.
  2. Flexible Pipe Coupling Bonds: Flexible copper straps with electrical resistance equal to No. 1/0 AWG stranded copper wire and with five holes for five exothermic welds to pipe.

3. Test Wires: No. 12 AWG, Type THWN copper conductors.
4. Resistance Wires: No. 16 or No. 22 AWG nickel-chromium wire.
5. Cables for Installation in Conduit: Type THWN copper conductors.

## 2.6 TEST STATIONS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Plastic Test Stations: Flush-mounted type, manufactured of high-impact-resistant PVC or polycarbonate with watertight conduit connections and cover and removable terminal board having at least five terminals.
- C. Test Station Mounting Enclosures:
  1. Non-Traffic-Area Boxes: Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems."
  2. Traffic-Area Boxes: Comply with requirements in Section 260543 "Underground Ducts and Raceways for Electrical Systems." Boxes shall have cast-iron covers with a welded bead legend "CP TEST."

## 2.7 SEALING, POTTING, AND DIELECTRIC COMPOUNDS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Sealing and Dielectric Insulating Compound: Comply with NACE RP0188. Black, rubber based, soft, permanently pliable, tacky, moldable, and unbacked; [**0.125 inch (3 mm)**] [**0.5 inch (13 mm)**] thick.
- C. Potting Compound: Comply with NACE RP0188. Cast-epoxy, two-package type; fabricated for this purpose and covered with heat-shrinkable tape.
- D. Pressure-Sensitive, Vinyl-Plastic Electrical Tape: Comply with UL 510.

## 2.8 EXOTHERMIC WELDING MATERIALS

- A. Exothermic Weld Kits: Specifically designed by manufacturer for welding materials and shapes required.
- B. Exothermic Weld Caps: Dome of high-density polyethylene, **10-mil (0.254-mm)** minimum thickness, filled with mastic and containing a tunnel portion to separate lead wire from exothermic weld.

## 2.9 COATING REPAIR MATERIALS

- A. Touchup Coating Materials: Comply with requirements in Section 099600 "High-Performance Coatings" for coating systems for touchup of factory-applied coatings.

- B. Adhesive-Applied Coating Materials: Coating materials shall be compatible with factory-applied coating system.
1. Nominal thickness of coating materials shall be not less than [8 mils (0.2 mm)] [16 mils (0.4 mm)] [24 mils (0.6 mm)] [40 mils (1.0 mm)] [60 mils (1.5 mm)] <Insert value>, plus or minus 5 percent.
  2. Coating materials shall be one of the following supplied by factory-applied coating system manufacturer:
    - a. Polyvinyl-chloride, pressure-sensitive, adhesive tape.
    - b. High-density polyethylene/bituminous rubber compound tape.
    - c. Butyl rubber tape.
    - d. Coal-tar epoxy.
    - e. <Insert coating material>.

### PART 3 - EXECUTION

#### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with ANSI/IEEE C2 and NFPA 70.
- B. Make connections to ferrous pipe[ **and metal tanks**] using exothermic welding.
- C. Coat welds with the coating repair material and apply an exothermic weld cap.

#### 3.2 MAGNESIUM ANODE INSTALLATION

- A. Install magnesium anodes at locations that clear obstructions. Install at least 36 inches (900 mm) and no more than 10 feet (3 m) from pipe[ **or tank**] to be protected. Install in augered holes with top of anode [24 inches (600 mm) below pipe invert elevation] [a minimum of 36 inches (900 mm) below finished grade]. In soils that will collapse into augered holes, use casing of galvanized sheet steel.
- B. Install anodes in a dry condition after plastic or waterproof protective covering has been completely removed from water-permeable permanent container that houses anode metal. Do not use anode-connecting wire for lowering anode into hole. Backfill annular space around anode with fine earth in 6-inch (150-mm) layers; compact each layer using hand tools. Do not strike anode or connecting wire during backfilling and compacting. After backfilling and compacting to within 6 inches (150 mm) of finished grade, pour approximately 5 gal. (20 L) of water into each filled hole. After water has been absorbed by earth, complete backfilling to finished level.
- C. If rock strata are encountered before achieving specified augured hole depth, install anodes horizontally at depth at least as deep as bottom of pipe to be protected.
- D. Install anodes spaced as indicated, [directly connected] [connected through a test station] to the pipeline, allowing slack in connecting wire to compensate for movement during backfill operation.

- E. For tank protection, connect groups of anodes to collector cable. Make contact, through a test station, with tank to be protected.
- F. Do not use resistance wires to reduce current output of individual or group anodes.

### 3.3 ZINC ANODE INSTALLATION

- A. Install zinc anode horizontally in a hole at least **3 inches (76 mm)** larger than anode. Install anode under new copper water tubing, including service lines, blowoffs, and air releases. Separate piping and anode by at least **24 inches (600 mm)**, but not more than **60 inches (1520 mm)**.
- B. Install anode midway between both ends of piping. Install anode wire in piping trench and connect to piping at an accessible location. Install anode wire in PVC conduit where rising out of the ground to the aboveground connection.

### 3.4 INSTALLATION OF REFERENCE ELECTRODES

- A. Install directly beneath the buried metallic component being protected.

### 3.5 CABLE AND WIRE INSTALLATION

- A. Install conductors, except anode wires, in PVC conduit with waterproof PVC junction boxes. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for conduit and its installation.
- B. Anode Wire Installation: Cover trench bottom for the anode wire with **3-inch (76-mm)** layer of sand or stone-free earth. Center wire on backfill layer and do not stretch or kink the conductor. Place backfill over wire in layers not exceeding **6 inches (150 mm)** deep, and compact each layer. Use clean fill, free from roots, vegetable matter, and refuse. Place cable underground-line warning tape within **18 inches (460 mm)** of finished grade, above cable and conduit.
- C. Bonding Conductors: Install conductors on metallic pipe and tanks, to and across buried flexible couplings, mechanical joints, and flanged joints except at places where insulating joints are specified. Welded and threaded joints are considered electrically continuous and do not require bonding.
  - 1. Install at least two bonds between parts requiring bonding.
  - 2. Bonding conductors must contain sufficient slack for anticipated movement between structures. Bonding conductors across pipe joints shall have not less than a **4-inch (100-mm)** slack for pipe expansion, contraction, and soil stress.
  - 3. Connect bonding conductors to pipe, coupling follower rings and coupling middle ring or sleeve. Connect bonding conductors with exothermic welds.
- D. For wire splicing, use compression connectors or exothermic welds.



### 3.6 TEST STATIONS

- A. Install test stations as follows:
  - 1. At 1000-foot (300-m) intervals.
  - 2. At insulating joints.
  - 3. At both ends of casings when casing material is included in the cathodic protection system.
  - 4. Where pipe crosses other metal pipes.
  - 5. Where pipe connects to existing piping system.
  - 6. Where pipe connects to dissimilar metal pipe.
  - 7. At each tank component.
- B. Install test stations on backfill complying with requirements for trench bottom fill for anode wires unless otherwise indicated.
- C. Terminate test conductors on terminal boards and install a spare set of test leads at each testing location.

### 3.7 PIPE JOINTS

- A. Insulating Flange Sets: Cover flanges with sealing and dielectric compound.
- B. Insulating Unions: Install electrical isolation at each building entrance and at other locations indicated on approved Delegated-Design Drawings. Cover unions with sealing and dielectric compound.

### 3.8 INSULATING PIPE SLEEVES

- A. Install insulating sleeves between metallic piping and metal buildings, hangers, supports, and other metal structures. Completely surround the metallic pipe for the full length of the steel contact and effectively prevent contact between the cathodically protected metallic pipe and other metallic structures. Support insulating sleeve to prevent damage to coating and to accommodate relative movement, vibrations, and temperature differentials.

### 3.9 DISSIMILAR METALS

- A. Underground Dissimilar Piping: Coat insulating joint and pipe at joints of dissimilar piping material with sealing and dielectric compound for a minimum distance of 10 pipe diameters on both sides of joint.
- B. Underground Dissimilar Valves: Coat dissimilar ferrous valves and pipe with sealing and dielectric compound for a minimum distance of 10 pipe diameters on both sides of valve.
- C. Aboveground Dissimilar Pipe and Valves: If dissimilar metal pipe joints and valves are not buried and are exposed only to atmosphere, coat connection or valve, including pipe, with sealing and dielectric compound for a minimum distance of three pipe diameters on both sides of junction.

### 3.10 COATINGS

- A. Field Joints: Apply adhesive-applied coating system in a thickness to achieve corrosion protection equal to adjacent factory-applied coating.

### 3.11 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
  - 1. Identify anode wires and anode header cables with marker tape.
  - 2. Identify underground wires and cables with underground-line warning tape.
  - 3. Identify text boxes with engraved, laminated acrylic or melamine label, permanently attached to text box.

### 3.12 FIELD QUALITY CONTROL

- A. Comply with NACE RP0169 and NACE RP0285.
- B. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installation, including connections.
- D. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- E. Tests and Inspections:
  - 1. Static Pull Test: Choose, at random, one completed anode of each type for this destructive test. Demonstrate that anode wire connections have enough strength to withstand a minimum tensile load of **300 lb (136 kg)**. If test fails, replace all anodes and repeat test at another randomly selected anode.
  - 2. Insulation Testing: Before anode system is connected to **[pipe]** **[and]** **[tank]**, test insulation at each insulating joint and fitting. Demonstrate that no metallic contact, or short circuit, exists between the two insulated sections of **[pipe]** **[and]** **[tank]**. Replace defective joints or fittings.
  - 3. Bonding Tests: Test for electrical continuity across all bonded joints. Repair or add additional bonds until electrical continuity is achieved.
  - 4. Baseline Potentials: After backfilling of **[pipe and]** **[pipe, tank, and]** anodes is completed, but before anodes are connected to **[pipe]** **[and]** **[tank]**, measure the static potential of **[pipe]** **[and]** **[tank]** to soil. Record initial measurements.
  - 5. Anode Output: Measure electrical current as anodes or groups of anodes are connected to **[pipe]** **[and]** **[tank]**. Use a low-resistance ammeter. Record current, date, time, and location of each measurement.

6. **[Pipe-] [and-] [Tank-]**to-Reference Electrode Potential Measurements: On completion of installation of entire cathodic protection system, make electrode potential measurements according to NACE RP0169, using a copper/copper-sulfate reference electrode and a potentiometer-voltmeter, or a dc voltmeter with an internal resistance (sensitivity) of not less than 100,000 ohms per volt and a full scale of 1 or 2 V. Make measurements at same locations as those used for baseline potentials. Record voltage, date, time, and location of each measurement, using one of the following two methods:
  - a. 0.85 V Negative Voltage: With cathodic system in operation, measure a negative voltage of at least minus 0.85 V between **[pipe] [or] [tank]** and a saturated copper/copper-sulfate reference electrode contacting the earth directly over **[pipe] [or] [tank]**.
  - b. 100-mV Polarization Voltage: Determine polarization voltage shift by interrupting protective current and measuring polarization decay. An immediate voltage shift will occur if protective current is interrupted. Use voltage reading, after immediate shift, as base reading from which to measure polarization decay. Measure at least a minimum polarization voltage shift of 100 mV between **[pipe] [or] [tank]** and a saturated copper/copper-sulfate reference electrode contacting the earth directly over **[pipe] [or] [tank]**.
- F. Location of Measurements for Piping: For coated piping or conduit, measure from reference electrode in contact with the earth directly over pipe. Measure at intervals not exceeding **400 feet (120 m)**. Make additional measurements at each distribution service riser, with reference electrode placed directly over service line.
- G. Location of Measurements for Tanks: For underground tanks, measure from reference electrode located as follows:
  1. Directly over center of tank.
  2. At a point directly over tank and midway between each pair of anodes.
  3. At each end of tank.
- H. Interference Testing: Test interference with cathodic protection from any foreign **[pipes] [and] [tanks]** in cooperation with Owner of foreign **[pipes] [and] [tanks]**. Report results and recommendations.
- I. Stray Current Measurements: Perform at each test station. Mitigate stray currents due to lightning or overhead ac power transmission lines as provided for in NACE standards.
- J. Inspect coatings; comply with NACE RP0188. Repair imperfections of factory-applied coatings as specified in "Coatings" Article.
  1. Use electronic holiday detectors to detect coating imperfections.
  2. All damage to the protective coating during transit and handling shall be repaired before installation.
  3. Repair factory-applied coatings to have equal or better corrosion resistance than the factory-applied coating system. Field-repair material shall be of the type approved by, and shall be applied as recommended by, manufacturer of the coating material.

## 3.13 ADJUSTING

- A. Adjust cathodic current using resistors as recommended by corrosion engineer who prepared the Delegated-Design Submittal in Part 1.
- B. During the first year after Substantial Completion, test, inspect, and adjust cathodic protection system every three months to ensure its continued compliance with specified requirements.

## 3.14 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain cathodic protection system.

END OF SECTION 134713

## SECTION 221113 - FACILITY WATER DISTRIBUTION PIPING

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes water-distribution piping and related components outside the building for [water service] [fire-service mains] [combined water service and fire-service mains].
- B. Utility-furnished products include water meters that will be furnished to the site, ready for installation.

## 1.3 DEFINITIONS

- A. EPDM: Ethylene propylene diene terpolymer rubber.
- B. LLDPE: Linear, low-density polyethylene plastic.
- C. PA: Polyamide (nylon) plastic.
- D. PE: Polyethylene plastic.
- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.
- G. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
- H. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

## 1.4 ACTION SUBMITTALS

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

- B. Shop Drawings: Detail precast concrete vault assemblies and indicate dimensions, method of field assembly, and components.

- 1. Wiring Diagrams: Power, signal, and control wiring for alarms.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: For piping and specialties including relation to other services in same area, drawn to scale. Show piping and specialty sizes and valves, meter and specialty locations, and elevations.

- B. Field quality-control test reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For water valves and specialties to include in emergency, operation, and maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Regulatory Requirements:

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

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

- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- D. Comply with ASTM F 645 for selection, design, and installation of thermoplastic water piping.

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

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

- G. NSF Compliance:

- 1. Comply with NSF 14 for plastic potable-water-service piping.[ **Include marking "NSF-pw" on piping.**]
  - 2. Comply with NSF 61 Annex G for materials for water-service piping and specialties for domestic water.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves, including fire hydrants, according to the following:
  - 1. Ensure that valves are dry and internally protected against rust and corrosion.
  - 2. Protect valves against damage to threaded ends and flange faces.
  - 3. Set valves in best position for handling. Set valves closed to prevent rattling.
- B. During Storage: Use precautions for valves, including fire hydrants, according to the following:
  - 1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
  - 2. Protect from weather. Store indoors and maintain temperature higher than ambient dew-point temperature. Support off the ground or pavement in watertight enclosures when outdoor storage is necessary.
- C. Handling: Use sling to handle valves and fire hydrants if size requires handling by crane or lift. Rig valves to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.
- D. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- E. Protect stored piping from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.
- F. Protect flanges, fittings, and specialties from moisture and dirt.
- G. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## 1.9 PROJECT CONDITIONS

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

## 1.10 COORDINATION

- A. Coordinate connection to water main with utility company.

## PART 2 - PRODUCTS

## 2.1 COPPER TUBE AND FITTINGS

- A. Soft Copper Tube: [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**and**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**], water tube, annealed temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
  2. Copper, Pressure-Seal Fittings:
    - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
    - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
    - c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- B. Hard Copper Tube: [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**and**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**], water tube, drawn temper.
1. Copper, Solder-Joint Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint pressure type. Furnish only wrought-copper fittings if indicated.
  2. Copper, Pressure-Seal Fittings:
    - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
    - b. **NPS 2 (DN 50)** and Smaller: Wrought-copper fitting with EPDM O-ring seal in each end.
    - c. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Bronze fitting with stainless-steel grip ring and EPDM O-ring seal in each end.
- C. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end. Furnish Class 300 flanges if required to match piping.
- D. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

## 2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.



2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  2. Gaskets: AWWA C111, rubber.
- C. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.
1. Grooved-End, Ductile-Iron Pipe Appurtenances:
    - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
    - b. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
    - c. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.
- D. Flanges: ASME 16.1, Class 125, cast iron.

## 2.3 PE PIPE AND FITTINGS

- A. PE, ASTM Pipe: ASTM D 2239, SIDR No. 5.3, 7, or 9; with PE compound number required to give pressure rating not less than [**160 psig (1100 kPa)**] [**200 psig (1380 kPa)**].
1. Insert Fittings for PE Pipe: ASTM D 2609, made of PA, PP, or PVC with serrated male insert ends matching inside of pipe. Include bands or crimp rings.
  2. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.
- B. PE, AWWA Pipe: AWWA C906, DR No. 7.3, 9, or 9.3; with PE compound number required to give pressure rating not less than [**160 psig (1100 kPa)**] [**200 psig (1380 kPa)**].
1. PE, AWWA Fittings: AWWA C906, socket- or butt-fusion type, with DR number matching pipe and PE compound number required to give pressure rating not less than [**160 psig (1100 kPa)**] [**200 psig (1380 kPa)**].
- C. PE, Fire-Service Pipe: ASTM F 714, AWWA C906, or equivalent for PE water pipe; FMG approved, with minimum thickness equivalent to FMG [**Class 150**] [**and**] [**Class 200**].
1. Molded PE Fittings: ASTM D 3350, PE resin, socket- or butt-fusion type, made to match PE pipe dimensions and class.

## 2.4 PVC PIPE AND FITTINGS

- A. PVC, Schedule 40 Pipe: ASTM D 1785.

1. PVC, Schedule 40 Socket Fittings: ASTM D 2466.
- B. PVC, Schedule 80 Pipe: ASTM D 1785.
1. PVC, Schedule 80 Socket Fittings: ASTM D 2467.
  2. PVC, Schedule 80 Threaded Fittings: ASTM D 2464.
- C. PVC, AWWA Pipe: AWWA C900, **[Class 150] [and] [Class 200]**, with bell end with gasket, and with spigot end.
1. Comply with UL 1285 for fire-service mains if indicated.
  2. PVC Fabricated Fittings: AWWA C900, **[Class 150] [and] [Class 200]**, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
  3. PVC Molded Fittings: AWWA C907, Class 150, with bell-and-spigot or double-bell ends. Include elastomeric gasket in each bell.
  4. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.
  5. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

## 2.5 FIBERGLASS PIPE AND FITTINGS

- A. AWWA RTRP: AWWA C950, **[Class 150] [Class 200] [and] [Class 250]**, Type I **[or II]**, **[Grade 1, epoxy] [or] [Grade 2, polyester]**, with bell-and-spigot ends **[for bonded] [with gasket or seal for gasketed]** joints. Liner is optional, unless otherwise indicated. **[Include FMG approval if used for fire-service mains.]**
1. RTRF: AWWA C950, similar to pipe in material, pressure class, and joining method.
- B. UL RTRP: UL 1713, **[Class 150] [Class 200] [and] [Class 250]**, with bell-and-spigot ends with gasket or seal for gasketed joints. Liner is optional, unless otherwise indicated.
1. RTRF: Similar to pipe in material, pressure class, and joining method.

## 2.6 SPECIAL PIPE FITTINGS

- A. Ductile-Iron Rigid Expansion Joints:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Three-piece, ductile-iron assembly consisting of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110 or AWWA C153. Select and assemble components for expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

- a. Pressure Rating: 250 psig (1725 kPa) minimum.
- b. Expansion Required: <Insert inches (mm)>.

B. Ductile-Iron Flexible Expansion Joints:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
  - a. Pressure Rating: 250 psig (1725 kPa) minimum.
  - b. Offset: <Insert inches (mm)>.
  - c. Expansion Required: <Insert inches (mm)>.

C. Ductile-Iron Deflection Fittings:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Compound, ductile-iron coupling fitting with sleeve and 1 or 2 flexing sections for up to 15-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
  - a. Pressure Rating: 250 psig (1725 kPa) minimum.

## 2.7 JOINING MATERIALS

- A. Refer to Section 330500 "Common Work Results for Utilities" for commonly used joining materials.
- B. Brazing Filler Metals: AWS A5.8, BCuP Series.
- C. Bonding Adhesive for Fiberglass Piping: As recommended by fiberglass piping manufacturer.
- D. Plastic Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

## 2.8 PIPING SPECIALTIES

- A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.
- B. Tubular-Sleeve Pipe Couplings:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

- a. Standard: AWWA C219.
- b. Center-Sleeve Material: [**Manufacturer's standard**] [**Carbon steel**] [**Stainless steel**] [**Ductile iron**] [**Malleable iron**].
- c. Gasket Material: Natural or synthetic rubber.
- d. Pressure Rating: [**150 psig (1035 kPa)**] [**200 psig (1380 kPa)**] <Insert pressure> minimum.
- e. Metal Component Finish: Corrosion-resistant coating or material.

C. Split-Sleeve Pipe Couplings:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Metal, bolted, split-sleeve-type, reducing or transition coupling with sealing pad and closure plates, O-ring gaskets, and bolt fasteners.
  - a. Standard: AWWA C219.
  - b. Sleeve Material: [**Manufacturer's standard**] [**Carbon steel**] [**Stainless steel**].
  - c. Sleeve Dimensions: Of thickness and width required to provide pressure rating.
  - d. Gasket Material: O-rings made of EPDM rubber, unless otherwise indicated.
  - e. Pressure Rating: [**150 psig (1035 kPa)**] [**200 psig (1380 kPa)**] <Insert pressure> minimum.
  - f. Metal Component Finish: Corrosion-resistant coating or material.

D. Flexible Connectors:

1. Nonferrous-Metal Piping: Bronze hose covered with bronze wire braid; with copper-tube, pressure-type, solder-joint ends or bronze flanged ends brazed to hose.
2. Ferrous-Metal Piping: Stainless-steel hose covered with stainless-steel wire braid; with ASME B1.20.1, threaded steel pipe nipples or ASME B16.5, steel pipe flanges welded to hose.

E. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Pressure Rating: [**125 psig (860 kPa) minimum at 180 deg F (82 deg C)**] [**150 psig (1035 kPa)**] [**250 psig (1725 kPa)**].
    - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
  - a. Description:
    - 1) Standard: ASSE 1079.
    - 2) Factory-fabricated, bolted, companion-flange assembly.

- 3) Pressure Rating: [**125 psig (860 kPa) minimum at 180 deg F (82 deg C)**] [**150 psig (1035 kPa)**] [**175 psig (1200 kPa)**] [**300 psig (2070 kPa)**].
  - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
- a. Description:
    - 1) Nonconducting materials for field assembly of companion flanges.
    - 2) Pressure Rating: [**150 psig (1035 kPa)**] <Insert pressure>.
    - 3) Gasket: Neoprene or phenolic.
    - 4) Bolt Sleeves: Phenolic or polyethylene.
    - 5) Washers: Phenolic with steel backing washers.
5. Dielectric Nipples:
- a. Description:
    - 1) Standard: IAPMO PS 66
    - 2) Electroplated steel nipple complying with ASTM F 1545.
    - 3) Pressure Rating: [**300 psig (2070 kPa) at 225 deg F (107 deg C)**] <Insert pressure and temperature>.
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

## 2.9 CORROSION-PROTECTION PIPING ENCASEMENT

### A. Encasement for Underground Metal Piping:

1. Standards: ASTM A 674 or AWWA C105.
2. Form: [**Sheet**] [**Sheet or tube**] [**Tube**].
3. Material: LLDPE film of **0.008-inch (0.20-mm)** minimum thickness.
4. Material: LLDPE film of **0.008-inch (0.20-mm)** minimum thickness, or high-density, crosslaminated PE film of **0.004-inch (0.10-mm)** minimum thickness.
5. Material: High-density, crosslaminated PE film of **0.004-inch (0.10-mm)** minimum thickness.
6. Color: [**Black**] [**Natural**] <Insert color>.

## 2.10 GATE VALVES

### A. AWWA, Cast-Iron Gate Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Nonrising-Stem, Metal-Seated Gate Valves:
  - a. Description: Gray- or ductile-iron body and bonnet; with cast-iron or bronze double-disc gate, bronze gate rings, bronze stem, and stem nut.
    - 1) Standard: AWWA C500.

- 2) Minimum Pressure Rating: 200 psig (1380 kPa).
    - 3) End Connections: Mechanical joint.
    - 4) Interior Coating: Complying with AWWA C550.
  3. Nonrising-Stem, Resilient-Seated Gate Valves:
    - a. Description: Gray- or ductile-iron body and bonnet; with bronze or gray- or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      - 1) Standard: AWWA C509.
      - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
      - 3) End Connections: Mechanical joint.
      - 4) Interior Coating: Complying with AWWA C550.
  4. Nonrising-Stem, High-Pressure, Resilient-Seated Gate Valves:
    - a. Description: Ductile-iron body and bonnet; with bronze or ductile-iron gate, resilient seats, bronze stem, and stem nut.
      - 1) Standard: AWWA C509.
      - 2) Minimum Pressure Rating: 250 psig (1725 kPa).
      - 3) End Connections: Push on or mechanical joint.
      - 4) Interior Coating: Complying with AWWA C550.
  5. OS&Y, Rising-Stem, Metal-Seated Gate Valves:
    - a. Description: Cast- or ductile-iron body and bonnet, with cast-iron double disc, bronze disc and seat rings, and bronze stem.
      - 1) Standard: AWWA C500.
      - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
      - 3) End Connections: Flanged.
  6. OS&Y, Rising-Stem, Resilient-Seated Gate Valves:
    - a. Description: Cast- or ductile-iron body and bonnet, with bronze or gray- or ductile-iron gate, resilient seats, and bronze stem.
      - 1) Standard: AWWA C509.
      - 2) Minimum Pressure Rating: 200 psig (1380 kPa).
      - 3) End Connections: Flanged.
- B. UL/FMG, Cast-Iron Gate Valves:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. UL/FMG, Nonrising-Stem Gate Valves:
    - a. Description: Iron body and bonnet with flange for indicator post, bronze seating material, and inside screw.
      - 1) Standards: UL 262 and FMG approved.
      - 2) Minimum Pressure Rating: 175 psig (1207 kPa).

- 3) End Connections: Flanged.
3. OS&Y, Rising-Stem Gate Valves:
  - a. Description: Iron body and bonnet and bronze seating material.
    - 1) Standards: UL 262 and FMG approved.
    - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
    - 3) End Connections: Flanged.
- C. Bronze Gate Valves:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. OS&Y, Rising-Stem Gate Valves:
    - a. Description: Bronze body and bonnet and bronze stem.
      - 1) Standards: UL 262 and FMG approved.
      - 2) Minimum Pressure Rating: 175 psig (1207 kPa).
      - 3) End Connections: Threaded.
  3. Nonrising-Stem Gate Valves:
    - a. Description: Class 125, Type 1, bronze with solid wedge, threaded ends, and malleable-iron handwheel.
      - 1) Standard: MSS SP-80.

## 2.11 GATE VALVE ACCESSORIES AND SPECIALTIES

- A. Tapping-Sleeve Assemblies:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Sleeve and valve compatible with drilling machine.
    - a. Standard: MSS SP-60.
    - b. Tapping Sleeve: Cast- or ductile-iron or stainless-steel, two-piece bolted sleeve with flanged outlet for new branch connection. Include sleeve matching size and type of pipe material being tapped and with recessed flange for branch valve.
    - c. Valve: AWWA, cast-iron, nonrising-stem, [metal] [resilient]-seated gate valve with one raised face flange mating tapping-sleeve flange.
- B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes. Include top section, adjustable extension of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches (125 mm) in diameter.
  1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

- C. Indicator Posts: UL 789, FMG-approved, vertical-type, cast-iron body with operating wrench, extension rod, and adjustable cast-iron barrel of length required for depth of burial of valve.

## 2.12 CHECK VALVES

### A. AWWA Check Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Swing-check type with resilient seat. Include interior coating according to AWWA C550 and ends to match piping.
  - a. Standard: AWWA C508.
  - b. Pressure Rating: **175 psig (1207 kPa)**.

### B. UL/FMG, Check Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Swing-check type with pressure rating; rubber-face checks, unless otherwise indicated; and ends matching piping.
  - a. Standards: UL 312 and FMG approved.
  - b. Pressure Rating: [**175 psig (1207 kPa)**] [**250 psig (1725 kPa)**].

## 2.13 DETECTOR CHECK VALVES

### A. Detector Check Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.
  - a. Standards: UL 312 and FMG approved.
  - b. Pressure Rating: **175 psig (1207 kPa)**.
  - c. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.
3. Description: Iron body, corrosion-resistant clapper ring and seat ring material, flanged ends, with connections for bypass and installation of water meter.
  - a. Standards: UL 312 and FMG approved.
  - b. Pressure Rating: **175 psig (1207 kPa)**.

## 2.14 BUTTERFLY VALVES

### A. AWWA Butterfly Valves:



1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Rubber seated.
  - a. Standard: AWWA C504.
  - b. Body: Cast or ductile iron.
  - c. Body Type: [Wafer] [Wafer or flanged] [Flanged].
  - d. Pressure Rating: 150 psig (1035 kPa).

B. UL Butterfly Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Metal on resilient material seating.
  - a. Standards: UL 1091 and FMG approved.
  - b. Body: Cast or ductile iron.
  - c. Body Type: [Wafer] [Wafer or flanged] [Flanged].
  - d. Pressure Rating: 175 psig (1207 kPa).

## 2.15 PLUG VALVES

A. Plug Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Resilient-seated eccentric.
  - a. Standard: MSS SP-108.
  - b. Body: Cast iron.
  - c. Pressure Rating: 175-psig (1207-kPa) minimum CWP.
  - d. Seat Material: Suitable for potable-water service.

## 2.16 [CORPORATION VALVES] [AND] [CURB VALVES]

A. Manufacturers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

B. Service-Saddle Assemblies: Comply with AWWA C800. Include saddle and valve compatible with tapping machine.

1. Service Saddle: Copper alloy with seal and AWWA C800, threaded outlet for corporation valve.
2. Corporation Valve: Bronze body and ground-key plug, with AWWA C800, threaded inlet and outlet matching service piping material.
3. Manifold: Copper fitting with two to four inlets as required, with ends matching corporation valves and outlet matching service piping material.

C. Curb Valves: Comply with AWWA C800. Include bronze body, ground-key plug or ball, and wide tee head, with inlet and outlet matching service piping material.

- D. Service Boxes for Curb Valves: Similar to AWWA M44 requirements for cast-iron valve boxes. Include cast-iron telescoping top section of length required for depth of burial of valve, plug with lettering "WATER," and bottom section with base that fits over curb valve and with a barrel approximately 3 inches (75 mm) in diameter.
  - 1. Shutoff Rods: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve.

## 2.17 WATER METERS

- A. Water meters will be furnished by utility company.
- B. Manufacturers:
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Displacement-Type Water Meters:
  - 1. Description: With bronze main case.
    - a. Standard: AWWA C700.
    - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- D. Turbine-Type Water Meters:
  - 1. Description:
    - a. Standard: AWWA C701.
    - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- E. Compound-Type Water Meters:
  - 1. Description:
    - a. Standard: AWWA C702.
    - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- F. Remote Registration System:
  - 1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
    - a. Standard: AWWA C706.
    - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- G. Remote Registration System:
  - 1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.

- a. Standard: AWWA C707.
- b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
- c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
- d. Visible Display Units: Comply with utility company requirements for type and quantity.

## 2.18 DETECTOR-TYPE WATER METERS

### A. Detector-Type Water Meters:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

### B. Description: Main line, proportional meter with second meter on bypass. Register flow in [gallons (liters)] [cubic feet (cubic meters)].

1. Standards: AWWA C703, UL listed, and FMG approved.
2. Pressure Rating: 150 psig (1035 kPa).
3. Bypass Meter: [AWWA C701, turbine] [AWWA C702, compound]-type, bronze case.
  - a. Size: At least one-half nominal size of main-line meter.

### C. Description: Main-line turbine meter with strainer and second meter on bypass. Register flow in [gallons (liters)] [cubic feet (cubic meters)].

1. Standards: AWWA C703, UL listed, and FMG approved.
2. Pressure Rating: 175 psig (1207 kPa).
3. Bypass Meter: AWWA C701, turbine-type, bronze case.
  - a. Size: At least NPS 2 (DN 50).

### D. Remote Registration System:

1. Description: Utility company standard; direct-reading type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
  - a. Standard: AWWA C706.
  - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].

### E. Remote Registration System:

1. Description: Utility company standard; encoder type. Include meter modified with signal-transmitting assembly, low-voltage connecting wiring, and remote register assembly.
  - a. Standard: AWWA C707.
  - b. Registration: Flow in [gallons (liters)] [cubic feet (cubic meters)].
  - c. Data-Acquisition Units: Comply with utility company requirements for type and quantity.
  - d. Visible Display Units: Comply with utility company requirements for type and quantity.

## 2.19 PRESSURE-REDUCING VALVES

## A. Water Regulators:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standard: ASSE 1003.
3. Pressure Rating: Initial pressure of **150 psig (1035 kPa)**.
4. Size: **<Insert NPS (DN)>**.
5. Design Flow Rate: **<Insert gpm (L/s)>**.
6. Design Inlet Pressure: **<Insert psig (kPa)>**.
7. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.
8. Body: Bronze[ **with chrome-plated finish**] for **NPS 2 (DN 50)** and smaller; cast iron[ **with interior lining complying with AWWA C550 or that is FDA approved**] for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.

## B. Water Control Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
  - a. Pressure Rating: Initial pressure of **150 psig (1035 kPa)** minimum.
  - b. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
    - 1) Size: **<Insert NPS (DN)>**.
    - 2) Pattern: [**Angle**] [**Globe**]-valve design.
    - 3) Trim: Stainless steel.
  - c. Design Flow Rate: **<Insert gpm (L/s)>**.
  - d. Design Inlet Pressure: **<Insert psig (kPa)>**.
  - e. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.
  - f. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; [**flanged**] **<Insert type>** for **NPS 2-1/2 (DN 65)** and larger.

## 2.20 RELIEF VALVES

## A. Air-Release Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Hydromechanical device to automatically release accumulated air.
  - a. Standard: AWWA C512.
  - b. Pressure Rating: [**300 psig (2070 kPa)**] **<Insert pressure>**.
  - c. Body Material: [**Cast iron**] **<Insert material>**.
  - d. Trim Material: Stainless steel[, **brass, or bronze**].

- e. Water Inlet Size: <Insert **NPS (DN)**>.
- f. Air Outlet Size: <Insert **NPS (DN)**>.
- g. Orifice Size: <Insert **inch (mm)**>.
- h. Design Air-Release Capacity: <Insert **cfm (L/s)**> at <Insert **psig (kPa)**> pipeline pressure.

B. Air/Vacuum Valves:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description: Direct-acting, float-operated, hydromechanical device with large orifice to automatically release accumulated air or to admit air during filling of piping.
  - a. Standard: AWWA C512.
  - b. Pressure Rating: [**300 psig (2070 kPa)**] <Insert pressure>.
  - c. Body Material: [**Cast iron**] <Insert material>.
  - d. Trim Material: Stainless steel[, **brass, or bronze**].
  - e. Inlet and Outlet Size: <Insert **NPS (DN)**>.
  - f. Orifice Size: <Insert **inch (mm)**>.
  - g. Design Air Capacity: <Insert **cfm (L/s)**> at <Insert **psig (kPa)**> differential pressure.

C. Combination Air Valves:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description: Float-operated, hydromechanical device to automatically release accumulated air or to admit air.
  - a. Standard: AWWA C512.
  - b. Pressure Rating: [**300 psig (2070 kPa)**] <Insert pressure>.
  - c. Body Material: [**Cast iron**] <Insert material>.
  - d. Trim Material: Stainless steel[, **brass, or bronze**].
  - e. Inlet and Outlet Size: <Insert **NPS (DN)**>.
  - f. Orifice Size: <Insert **inch (mm)**>.
  - g. Design Air Capacity: <Insert **cfm (L/s)**> at <Insert **psig (kPa)**> differential pressure.

## 2.21 VACUUM BREAKERS

A. Pressure Vacuum Breaker Assembly:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: [**5 psig (35 kPa)**] <Insert pressure> maximum, through middle 1/3 of flow range.
- 5. Size: <Insert **NPS (DN)**>.
- 6. Design Flow Rate: <Insert **gpm (L/s)**>.
- 7. Selected Unit Flow Range Limits: <Insert **gpm (L/s)**>.
- 8. Pressure Loss at Design Flow Rate: <Insert **psig (kPa)**>.
- 9. Accessories: Ball valves on inlet and outlet.

## 2.22 BACKFLOW PREVENTERS

## A. Reduced-Pressure-Principle Backflow Preventers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standard: [ASSE 1013] [or] [AWWA C511].
3. Operation: Continuous-pressure applications.
4. Pressure Loss: [12 psig (83 kPa)] <Insert pressure> maximum, through middle 1/3 of flow range.
5. Size: <Insert NPS (DN)>.
6. Design Flow Rate: <Insert gpm (L/s)>.
7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
9. Body: Bronze for NPS 2 (DN 50) and smaller; [cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 (DN 65) and larger.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; [flanged] <Insert type> for NPS 2-1/2 (DN 65) and larger.
11. Configuration: Designed for [horizontal, straight through] [vertical inlet, horizontal center section, and vertical outlet] [vertical] <Insert configuration> flow.
12. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 (DN 50) and smaller; OS&Y gate type with flanged ends on inlet and outlet of NPS 2-1/2 (DN 65) and larger.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.

## B. Double-Check, Backflow-Prevention Assemblies:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standard: [ASSE 1015] [or] [AWWA C510].
3. Operation: Continuous-pressure applications, unless otherwise indicated.
4. Pressure Loss: [5 psig (35 kPa)] <Insert pressure> maximum, through middle 1/3 of flow range.
5. Size: <Insert NPS (DN)>.
6. Design Flow Rate: <Insert gpm (L/s)>.
7. Selected Unit Flow Range Limits: <Insert gpm (L/s)>.
8. Pressure Loss at Design Flow Rate: <Insert psig (kPa)> for NPS 2 (DN 50) and smaller; <Insert psig (kPa)> for NPS 2-1/2 (DN 65) and larger.
9. Body: Bronze for NPS 2 (DN 50) and smaller; [cast iron with interior lining complying with AWWA C550 or that is FDA approved] [steel with interior lining complying with AWWA C550 or that is FDA approved] [stainless steel] for NPS 2-1/2 (DN 65) and larger.
10. End Connections: Threaded for NPS 2 (DN 50) and smaller; [flanged] <Insert type> for NPS 2-1/2 (DN 65) and larger.
11. Configuration: Designed for [horizontal, straight through] <Insert configuration> flow.

12. Accessories: Ball valves with threaded ends on inlet and outlet of **NPS 2 (DN 50)** and smaller; OS&Y gate valves with flanged ends on inlet and outlet of **NPS 2-1/2 (DN 65)** and larger.

C. Reduced-Pressure-Detector, Fire-Protection Backflow Preventer Assemblies:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standards: ASSE 1047 and UL listed or FMG approved.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: [**12 psig (83 kPa)**] **<Insert pressure>** maximum, through middle 1/3 of flow range.
5. Size: **<Insert NPS (DN)>**.
6. Design Flow Rate: **<Insert gpm (L/s)>**.
7. Selected Unit Flow Range Limits: **<Insert gpm (L/s)>**.
8. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>**.
9. Body: [**Cast iron with interior lining complying with AWWA C550 or that is FDA approved**] [**Steel with interior lining complying with AWWA C550 or that is FDA approved**] [**Stainless steel**].
10. End Connections: Flanged.
11. Configuration: Designed for [**horizontal, straight through**] [**vertical inlet, horizontal center section, and vertical outlet**] [**vertical**] **<Insert configuration>** flow.
12. Accessories:
  - a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow preventer connection.
  - c. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

D. Double-Check, Detector-Assembly Backflow Preventers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standards: ASSE 1048 and UL listed or FMG approved.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: [**5 psig (35 kPa)**] **<Insert pressure>** maximum, through middle 1/3 of flow range.
5. Size: **<Insert NPS (DN)>**.
6. Design Flow Rate: **<Insert gpm (L/s)>**.
7. Selected Unit Flow Range Limits: **<Insert gpm (L/s)>**.
8. Pressure Loss at Design Flow Rate: **<Insert psig (kPa)>**.
9. Body: [**Cast iron with interior lining complying with AWWA C550 or that is FDA approved**] [**Steel with interior lining complying with AWWA C550 or that is FDA approved**] [**Stainless steel**].
10. End Connections: Flanged.
11. Configuration: Designed for [**horizontal, straight through**] [**vertical inlet, horizontal center section, and vertical outlet**] [**vertical**] **<Insert configuration>** flow.
12. Accessories:
  - a. Valves: UL 262, FMG-approved, OS&Y gate type with flanged ends on inlet and outlet.

- b. Bypass: With displacement-type water meter, shutoff valves, and reduced-pressure backflow preventer.

E. Backflow Preventer Test Kits:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.23 WATER METER BOXES

- A. Description: Cast-iron body and cover for disc-type water meter, with lettering "WATER METER" in cover; and with slotted, open-bottom base section of length to fit over service piping.
  1. Option: Base section may be cast-iron, PVC, clay, or other pipe.
- B. Description: Cast-iron body and double cover for disc-type water meter, with lettering "WATER METER" in top cover; and with separate inner cover; air space between covers; and slotted, open-bottom base section of length to fit over service piping.
- C. Description: Polymer-concrete body and cover for disc-type water meter, with lettering "WATER" in cover; and with slotted, open-bottom base section of length to fit over service piping. Include vertical and lateral design loadings of **15,000 lb minimum over 10 by 10 inches (6800 kg minimum over 254 by 254 mm)** square.

## 2.24 CONCRETE VAULTS

- A. Description: Precast, reinforced-concrete vault, designed for A-16 load designation according to ASTM C 857 and made according to ASTM C 858.
  1. Ladder: ASTM A 36/A 36M, steel or polyethylene-encased steel steps.
  2. Manhole: ASTM A 48/A 48M Class No. 35A minimum tensile strength, gray-iron traffic frame and cover.
    - a. Dimension: **24-inch (610-mm)** minimum diameter, unless otherwise indicated.
  3. Manhole: ASTM A 536, Grade 60-40-18, ductile-iron traffic frame and cover.
    - a. Dimension: **24-inch- (610-mm-)** minimum diameter, unless otherwise indicated.
  4. Drain: ASME A112.6.3, cast-iron floor drain with outlet of size indicated. Include body anchor flange, light-duty cast-iron grate, bottom outlet, and integral or field-installed bronze ball or clapper-type backwater valve.

## 2.25 PROTECTIVE ENCLOSURES

- A. Freeze-Protection Enclosures:



1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Insulated enclosure designed to protect aboveground water piping, equipment, or specialties from freezing and damage, with heat source to maintain minimum internal temperature of 40 deg F (4 deg C) when external temperatures reach as low as minus 34 deg F (minus 36 deg C).
  - a. Standard: ASSE 1060.
  - b. Class I: For equipment or devices other than pressure or atmospheric vacuum breakers.
  - c. Class I-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
    - 1) Housing: Reinforced[-aluminum] [or] [-fiberglass] <Insert housing> construction.
      - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
      - b) Drain opening for units with drain connection.
      - c) Access doors with locking devices.
      - d) Insulation inside housing.
      - e) Anchoring devices for attaching housing to concrete base.
    - 2) Electric heating cable or heater with self-limiting temperature control.

B. Weather-Resistant Enclosures:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Uninsulated enclosure designed to protect aboveground water piping, equipment, or specialties from weather and damage.
  - a. Standard: ASSE 1060.
  - b. Class III: For equipment or devices other than pressure or atmospheric vacuum breakers.
  - c. Class III-V: For pressure or atmospheric vacuum breaker equipment or devices. Include drain opening in housing.
    - 1) Housing: Reinforced[-aluminum] [or] [-fiberglass] <Insert housing> construction.
      - a) Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
      - b) Drain opening for units with drain connection.
      - c) Access doors with locking devices.
      - d) Anchoring devices for attaching housing to concrete base.

C. Expanded-Metal Enclosures:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Enclosure designed to protect aboveground water piping, equipment, or specialties from damage.

- a. Material: ASTM F 1267, expanded metal side and top panels, of weight and with reinforcement of same metal at edges as required for rigidity.
- b. Type: Type[ **I, expanded**] [ **II, expanded and flattened**].
- c. Class: Class[ **1, uncoated carbon steel**] [ **2, hot-dip, zinc-coated carbon steel**] [ **3, corrosion-resisting steel**].
- d. Finish: Manufacturer's enamel paint.
- e. Size: Of dimensions indicated, but not less than those required for access and service of protected unit.
- f. Locking device.
- g. Lugs or devices for securing enclosure to base.

D. Enclosure Bases:

1. Description: [~~4-inch- (100-mm-)~~] [~~6-inch- (150-mm-)~~] minimum thickness precast concrete, of dimensions required to extend at least **6 inches (150 mm)** beyond edges of enclosure housings. Include openings for piping.

## 2.26 FIRE HYDRANTS

A. Dry-Barrel Fire Hydrants:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
  - a. Standard: AWWA C502.
  - b. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**250 psig (1725 kPa)**].
3. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **5-1/4-inch (133-mm)** main valve, drain valve, and **NPS 6 (DN 150)** mechanical-joint inlet. Hydrant shall have cast-iron body, compression-type valve opening against pressure and closing with pressure.
  - a. Standards: UL 246, FMG approved.
  - b. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**250 psig (1725 kPa)**].
  - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
  - d. Operating and Cap Nuts: Pentagon, **1-1/2 inches (38 mm)** point to flat.
  - e. Direction of Opening: Open hydrant valve by turning operating nut to left or counterclockwise.
  - f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

B. Wet-Barrel Fire Hydrants:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Freestanding, with one **NPS 4-1/2 (DN 115)** and two **NPS 2-1/2 (DN 65)** outlets, **NPS 6 (DN 150)** threaded or flanged inlet, and base section with **NPS 6 (DN 150)** mechanical-joint inlet. Include interior coating according to AWWA C550.

- a. Standard: AWWA C503.
  - b. Pressure Rating: 150 psig (1035 kPa) minimum.
3. Description: Freestanding, with one NPS 4-1/2 (DN 115) and two NPS 2-1/2 (DN 65) outlets, NPS 6 (DN 150) threaded or flanged inlet, and base section with NPS 6 (DN 150) mechanical-joint inlet.
    - a. Standards: UL 246 and FMG approved.
    - b. Pressure Rating: 150 psig (1035 kPa) minimum.
    - c. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.
    - d. Operating and Cap Nuts: Pentagon, 1-1/2 inches (38 mm) point to flat.
    - e. Direction of Opening: Open hydrant valves by turning operating nut to left or counterclockwise.
    - f. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.

## 2.27 FLUSHING HYDRANTS

### A. Post-Type Flushing Hydrants:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
  - a. Pressure Rating: 150 psig (1035 kPa) minimum.
  - b. Outlet: One, with horizontal discharge.
  - c. Hose Thread: NPS 2-1/2 (DN 65), with NFPA 1963 external hose thread for use by local fire department, and with cast-iron cap with brass chain.
  - d. Barrel: Cast-iron or steel pipe with breakaway feature.
  - e. Valve: Bronze body with bronze-ball or plunger closure, and automatic draining.
  - f. Security: Locking device for padlock.
  - g. Exterior Finish: Red alkyd-gloss enamel paint, unless otherwise indicated.
  - h. Inlet: NPS 2 (DN 50) minimum.
  - i. Operating Wrench: One for each unit.

### B. Ground-Type Flushing Hydrants:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
  - a. Pressure Rating: 150 psig (1035 kPa) minimum.
  - b. Outlet: One, with [vertical] [angle] discharge.
  - c. Hose Thread: NPS 2-1/2 (DN 65), with NFPA 1963 external hose thread for use by local fire department, and with cast-iron cap with brass chain.
  - d. Barrel: Cast-iron or steel pipe.
  - e. Valve: Bronze body with bronze-ball or plunger closure, and automatic draining.
  - f. Inlet: NPS 2 (DN 50) minimum.
  - g. Hydrant Box: Cast iron with cover, for ground mounting.
  - h. Operating Wrench: One for each unit.

## C. Post-Type Sampling Station:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Nonfreeze and drainable, of length required for shutoff valve installation below frost line.
  - a. Pressure Rating: **100 psig (690 kPa)** minimum.
  - b. Sampling Outlet: One unthreaded nozzle with handle.
  - c. Valve: Bronze body with bronze-ball or plunger closure. Include operating handle.
  - d. Drain: Tubing with separate manual vacuum pump.
  - e. Inlet: **NPS 3/4 (DN 20)** minimum.
  - f. Housing: Weatherproof material with locking device. Include anchor device.
  - g. Operating Wrench: One for each unit.

## 2.28 FIRE DEPARTMENT CONNECTIONS

## A. Fire Department Connections:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Freestanding, with cast-bronze body, thread inlets according to NFPA 1963 and matching local fire department hose threads, and threaded bottom outlet. Include lugged caps, gaskets, and chains; lugged swivel connection and drop clapper for each hose-connection inlet; **18-inch- (460-mm-)** high brass sleeve; and round escutcheon plate.
  - a. Standard: UL 405.
  - b. Connections: Two **NPS 2-1/2 (DN 65)** inlets and one [**NPS 4 (DN 100)**] [**NPS 6 (DN 150)**] outlet.
  - c. Connections: [**Three**] [**Four**] **NPS 2-1/2 (DN 65)** inlets and one **NPS 6 (DN 150)** outlet.
  - d. Connections: Six **NPS 2-1/2 (DN 65)** inlets and one [**NPS 6 (DN 150)**] [**NPS 8 (DN 200)**] outlet.
  - e. Inlet Alignment: [**Inline, horizontal**] [**Square**].
  - f. Finish Including Sleeve: [**Polished chrome-plated**] [**Rough chrome-plated**] [**Polished bronze**].
  - g. Escutcheon Plate Marking: "[**AUTO SPKR**] [**&**] [**STANDPIPE**]."

## 2.29 ALARM DEVICES

- A. Alarm Devices, General: UL 753 and FMG approved, of types and sizes to mate and match piping and equipment.
- B. Water-Flow Indicators: Vane-type water-flow detector, rated for **250-psig (1725-kPa)** working pressure; designed for horizontal or vertical installation; with 2 single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.
- C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

- D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

### PART 3 - EXECUTION

#### 3.1 EARTHWORK

- A. Refer to Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

#### 3.2 PIPING APPLICATIONS

- A. General: Use pipe, fittings, and joining methods for piping systems according to the following applications.
- B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.
- C. Do not use flanges or unions for underground piping.
- D. Flanges, unions, grooved-end-pipe couplings, and special fittings may be used, instead of joints indicated, on aboveground piping and piping in vaults.
- E. Underground water-service piping [**NPS 3/4 to NPS 3 (DN 20 to DN 80)**] <Insert pipe size range> shall be[ **any of**] the following:
  - 1. Soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; [wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed] joints.
  - 2. PE, ASTM pipe; [insert fittings for PE pipe; and clamped] [molded PE fittings; and heat-fusion] joints.
  - 3. PVC, Schedule [**40 pipe; PVC, Schedule 40**] [**80 pipe; PVC, Schedule 80**] socket fittings; and solvent-cemented joints.
  - 4. **NPS 1 to NPS 3 (DN 25 to DN 80)** fiberglass, AWWA RTRP, Class [**150**] [**200**] [**250**]; RTRF; and bonded joints.
  - 5. Fiberglass, AWWA RTRP, Class [**150**] [**200**] [**250**]; RTRF; and bonded joints.
- F. Underground water-service piping [**NPS 4 to NPS 8 (DN 100 to DN 200)**] <Insert pipe size range> shall be[ **any of**] the following:
  - 1. Soft copper tube, [**ASTM B 88, Type K (ASTM B 88M, Type A)**] [**ASTM B 88, Type L (ASTM B 88M, Type B)**]; wrought-copper, solder-joint fittings; and brazed joints.
  - 2. Ductile-iron, [push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed] [mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical] [grooved-end pipe; ductile-iron-pipe appurtenances; and grooved] joints.
  - 3. PE, AWWA pipe; PE, AWWA fittings; and heat-fusion joints.
  - 4. PVC, Schedule [**40 pipe; PVC, Schedule 40**] [**80 pipe; PVC, Schedule 80**] socket fittings; and solvent-cemented joints.

5. **NPS 4 and NPS 6 (DN 100 and DN 150): NPS 6 (DN 150)** PVC, AWWA Class 150 pipe; PVC, AWWA Class 150 **[fabricated] [or] [molded]** fittings; and gasketed joints.
  6. **NPS 8 (DN 200):** PVC, AWWA Class 200 pipe; **[PVC, AWWA Class 200 fabricated] [push-on-joint, ductile-iron] [mechanical-joint, ductile-iron]** fittings; and gasketed joints.
  7. Fiberglass, AWWA RTRP, Class **[150] [200] [250]**; RTRF; and bonded joints.
- G. Water Meter Box Water-Service Piping **[NPS 3/4 to NPS 2 (DN 20 to DN 50)]** <Insert pipe size range> shall be same as underground water-service piping.
- H. Aboveground[ **and Vault**] Water-Service Piping **[NPS 3/4 to NPS 3 (DN 20 to DN 80)]** <Insert pipe size range> shall be[ **any of**] the following:
1. Hard copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; **[wrought-copper, solder-joint fittings; and brazed] [copper, pressure-seal fittings; and pressure-sealed]** joints.
  2. PVC, Schedule 80 pipe; PVC, Schedule 80 **[socket fittings; and solvent-cemented] [threaded fittings; and threaded]** joints.
  3. **NPS 1 to NPS 2 (DN 25 to DN 50)** fiberglass, AWWA RTRP, Class **[150] [200] [250]**; RTRF; and bonded joints.
- I. Aboveground [**and vault**] water-service piping **[NPS 4 to NPS 8 (DN 100 to DN 200)]** <Insert pipe size range> shall be[ **any of**] the following:
1. Hard copper tube, **[ASTM B 88, Type K (ASTM B 88M, Type A)] [ASTM B 88, Type L (ASTM B 88M, Type B)]**; wrought-copper, solder-joint fittings; and brazed joints.
  2. Ductile-iron, grooved-end pipe; ductile-iron, grooved-end appurtenances; and grooved joints.
  3. PVC, Schedule 80 pipe; PVC, Schedule 80 **[socket fittings; and solvent-cemented] [threaded fittings; and threaded]** joints.
  4. Fiberglass, AWWA RTRP, Class **[150] [200] [250]**; RTRF; and bonded joints.
- J. Underground Fire-Service-Main Piping **[NPS 4 to NPS 12 (DN 100 to DN 300)]** <Insert pipe size range> shall be[ **any of**] the following:
1. Ductile-iron, **[push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed] [mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical] [grooved-end pipe; ductile-iron-pipe appurtenances; and grooved]** joints.
  2. PE, Class **[150] [200]**, fire-service pipe; molded PE fittings; and heat-fusion joints.
  3. PVC, AWWA Class 150 pipe listed for fire-protection service; PVC Class 150 fabricated or molded fittings; and gasketed joints.
  4. PVC, AWWA Class 200 pipe listed for fire-protection service; PVC Class 200 fabricated fittings; and gasketed joints.
  5. Fiberglass, AWWA, FMG-approved RTRP, Class **[150] [200]**; RTRF; and gasketed joints.
  6. Fiberglass, UL RTRP, Class **[150] [200] [250]**; RTRF; and gasketed joints.
- K. Aboveground[ **and Vault**] Fire-Service-Main Piping **[NPS 4 to NPS 12 (DN 100 to DN 300)]** <Insert pipe size range> shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

- L. Underground Combined Water-Service and Fire-Service-Main Piping [**NPS 6 to NPS 12 (DN 150 to DN 300)**] <Insert pipe size range> shall be **any of** the following:
1. Ductile-iron, [**push-on-joint pipe; ductile-iron, push-on-joint fittings; and gasketed**] [**mechanical-joint pipe; ductile-iron, mechanical-joint fittings; and mechanical**] [**grooved-end pipe; ductile-iron-pipe appurtenances; and grooved**] joints.
  2. PVC, AWWA Class [**150**] [**200**] pipe listed for fire-protection service; PVC fabricated or molded fittings of same class as pipe; and gasketed joints.
  3. Fiberglass, AWWA, FMG-approved RTRP, Class [**150**] [**200**]; RTRF; and gasketed joints.
- M. Aboveground[ **and Vault**] Combined Water Service and Fire-Service-Main Piping [**NPS 6 to NPS 12 (DN 150 to DN 300)**] <Insert pipe size range> shall be ductile-iron, grooved-end pipe; ductile-iron-pipe appurtenances; and grooved joints.

### 3.3 VALVE APPLICATIONS

- A. General Application: Use mechanical-joint-end valves for **NPS 3 (DN 80)** and larger underground installation. Use threaded- or flanged-end valves for installation in vaults. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts. Use corporation valves and curb valves with ends compatible with piping, for **NPS 2 (DN 50)** and smaller installation.
- B. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Underground Valves, **NPS 3 (DN 80)** and Larger: AWWA, cast-iron, nonrising-stem, [**metal**] [**resilient**] [**high-pressure, resilient**]-seated gate valves with valve box.
  2. Underground Valves, **NPS 4 (DN 100)** and Larger, for Indicator Posts: UL/FMG, cast-iron, nonrising-stem gate valves with indicator post.
  3. Use the following for valves in vaults and aboveground:
    - a. Gate Valves, **NPS 2 (DN 50)** and Smaller: Bronze, [**nonrising**] [**rising**] stem.
    - b. Gate Valves, **NPS 3 (DN 80)** and Larger: [**AWWA, cast iron, OS&Y rising stem, metal seated**] [**AWWA, cast iron, OS&Y rising stem, resilient seated**] [**UL/FMG, cast iron, OS&Y rising stem**].
    - c. Check Valves: [**AWWA C508**] [**UL/FMG**], swing type.
  4. Pressure-Reducing Valves: Use for water-service piping in vaults and aboveground to control water pressure.
  5. Relief Valves: Use for water-service piping in vaults and aboveground.
    - a. Air-Release Valves: To release accumulated air.
    - b. Air/Vacuum Valves: To release or admit large volume of air during filling of piping.
    - c. Combination Air Valves: To release or admit air.
  6. Detector Check Valves: Use for water-service piping in vaults and aboveground to detect unauthorized use of water.

### 3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. See Section 330500 "Common Work Results for Utilities" for piping-system common requirements.

### 3.5 PIPING INSTALLATION

- A. Water-Main Connection: Arrange with utility company for tap of size and in location indicated in water main.
- B. Water-Main Connection: Tap water main according to requirements of water utility company and of size and in location indicated.
- C. Make connections larger than **NPS 2 (DN 50)** with tapping machine according to the following:
  - 1. Install tapping sleeve and tapping valve according to MSS SP-60.
  - 2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
  - 3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
  - 4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.
- D. Make connections **NPS 2 (DN 50)** and smaller with drilling machine according to the following:
  - 1. Install service-saddle assemblies and corporation valves in size, quantity, and arrangement required by utility company standards.
  - 2. Install service-saddle assemblies on water-service pipe to be tapped. Position outlets for corporation valves.
  - 3. Use drilling machine compatible with service-saddle assemblies and corporation valves. Drill hole in main. Remove drilling machine and connect water-service piping.
  - 4. Install corporation valves into service-saddle assemblies.
  - 5. Install manifold for multiple taps in water main.
  - 6. Install curb valve in water-service piping with head pointing up and with service box.
- E. Comply with NFPA 24 for fire-service-main piping materials and installation.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
  - 2. Install copper tube and fittings according to CDA's "Copper Tube Handbook."
- F. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.
  - 1. Install PE corrosion-protection encasement according to ASTM A 674 or AWWA C105.
- G. Install PE pipe according to ASTM D 2774 and ASTM F 645.
- H. Install PVC, AWWA pipe according to ASTM F 645 and AWWA M23.
- I. Install fiberglass AWWA pipe according to AWWA M45.



- J. Bury piping with depth of cover over top at least [30 inches (750 mm)] <Insert dimension>, with top at least [12 inches (300 mm)] <Insert dimension> below level of maximum frost penetration, and according to the following:
1. Under Driveways: With at least [36 inches (910 mm)] <Insert dimension> cover over top.
  2. Under Railroad Tracks: With at least [48 inches (1220 mm)] <Insert dimension> cover over top.
  3. In Loose Gravelly Soil and Rock: With at least [12 inches (300 mm)] <Insert dimension> additional cover.
- K. Install piping by tunneling or jacking, or combination of both, under streets and other obstructions that cannot be disturbed.
- L. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.
1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.
- M. Sleeves are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- N. Mechanical sleeve seals are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- O. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.
- P. See Section 211200 "Fire-Suppression Standpipes," Section 211313 "Wet-Pipe Sprinkler Systems," and Section 211316 "Dry-Pipe Sprinkler Systems" for fire-suppression-water piping inside the building.
- Q. See Section 221116 "Domestic Water Piping" for potable-water piping inside the building.

### 3.6 JOINT CONSTRUCTION

- A. See Section 330500 "Common Work Results for Utilities" for basic piping joint construction.
- B. Make pipe joints according to the following:
1. Copper-Tubing, Pressure-Sealed Joints: Use proprietary crimping tool and procedure recommended by copper, pressure-seal-fitting manufacturer.
  2. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
  3. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.
  4. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.

5. PE Piping Insert-Fitting Joints: Use plastic insert fittings and fasteners according to fitting manufacturer's written instructions.
6. PVC Piping Gasketed Joints: Use joining materials according to AWWA C900. Construct joints with elastomeric seals and lubricant according to ASTM D 2774 or ASTM D 3139 and pipe manufacturer's written instructions.
7. Fiberglass Piping Bonded Joints: Use adhesive and procedure recommended by piping manufacturer.
8. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
  - a. Dielectric Fittings for [NPS 2 (DN 50)] <Insert pipe size> and Smaller: Use dielectric [nipples] [unions].
  - b. Dielectric Fittings for [NPS 2-1/2 to NPS 4 (DN 65 to DN 100)] <Insert pipe size range>: Use dielectric [flanges] [flange kits] [nipples].
  - c. Dielectric Fittings for [NPS 5 (DN 125)] <Insert pipe size> and Larger: Use dielectric flange kits.

### 3.7 ANCHORAGE INSTALLATION

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

### 3.8 VALVE INSTALLATION

- A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.
- B. AWWA Valves Other Than Gate Valves: Comply with AWWA C600 and AWWA M44.
- C. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

- D. UL/FMG, Valves Other Than Gate Valves: Comply with NFPA 24.
- E. MSS Valves: Install as component of connected piping system.
- F. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.
- G. Pressure-Reducing Valves: Install in vault or aboveground between shutoff valves. [**Install full-size valved bypass.**]
- H. Relief Valves: Comply with AWWA C512. Install aboveground with shutoff valve on inlet.

### 3.9 DETECTOR-CHECK VALVE INSTALLATION

- A. Install in vault or aboveground.
- B. Install for proper direction of flow. Install bypass with water meter, gate valves on each side of meter, and check valve downstream from meter.
- C. Support detector check valves, meters, shutoff valves, and piping on brick or concrete piers.

### 3.10 WATER METER INSTALLATION

- A. Install water meters, piping, and specialties according to utility company's written instructions.
- B. Water Meters: Install [**displacement**] [**turbine**]-type water meters, **NPS 2 (DN 50)** and smaller, in meter boxes with shutoff valves on water meter inlets. Include valves on water meter outlets and valved bypass around meters unless prohibited by authorities having jurisdiction.
- C. Water Meters: Install [**compound**] [**turbine**]-type water meters, **NPS 3 (DN 80)** and larger, in meter vaults. Include shutoff valves on water meter inlets and outlets and valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.
- D. Water Meters: Install detector-type water meters in meter vault according to AWWA M6. Include shutoff valves on water meter inlets and outlets and full-size valved bypass around meters. Support meters, valves, and piping on brick or concrete piers.

### 3.11 ROUGHING-IN FOR WATER METERS

- A. Rough-in piping and specialties for water meter installation according to utility company's written instructions.

### 3.12 VACUUM BREAKER ASSEMBLY INSTALLATION

- A. Install pressure vacuum breaker assemblies of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.

- B. Do not install pressure vacuum breaker assemblies in vault or other space subject to flooding.

### 3.13 BACKFLOW PREVENTER INSTALLATION

- A. Install backflow preventers of type, size, and capacity indicated. Include valves and test cocks. Install according to requirements of plumbing and health department and authorities having jurisdiction.
- B. Do not install backflow preventers that have relief drain in vault or in other spaces subject to flooding.
- C. Do not install bypass piping around backflow preventers.
- D. Support **NPS 2-1/2 (DN 65)** and larger backflow preventers, valves, and piping near floor and on brick or concrete piers.

### 3.14 WATER METER BOX INSTALLATION

- A. Install water meter boxes in paved areas flush with surface.
- B. Install water meter boxes in grass or earth areas with top [**2 inches (50 mm)**] **<Insert dimension>** above surface.

### 3.15 CONCRETE VAULT INSTALLATION

- A. Install precast concrete vaults according to ASTM C 891.

### 3.16 PROTECTIVE ENCLOSURE INSTALLATION

- A. Install concrete base level and with top approximately [**2 inches (50 mm)**] **<Insert measurement>** above grade.
- B. Install protective enclosure over valves and equipment.
- C. Anchor protective enclosure to concrete base.

### 3.17 FIRE HYDRANT INSTALLATION

- A. General: Install each fire hydrant with separate gate valve in supply pipe, anchor with restrained joints or thrust blocks, and support in upright position.
- B. Wet-Barrel Fire Hydrants: Install with valve below frost line. Provide for drainage.
- C. AWWA Fire Hydrants: Comply with AWWA M17.
- D. UL/FMG Fire Hydrants: Comply with NFPA 24.

### 3.18 FLUSHING HYDRANT INSTALLATION

- A. Install post-type flushing hydrants with valve below frost line and provide for drainage. Support in upright position. Include separate gate valve or curb valve and restrained joints in supply piping.
- B. Install ground-type flushing hydrants with valve below frost line and provide for drainage. Install hydrant box flush with grade. Include separate gate valve or curb valve and restrained joints in supply piping.
- C. Install sampling stations with valve below frost line and provide for drainage. Attach weather-resistant housing and support in upright position. Include separate curb valve in supply piping.

### 3.19 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valves at each check valve for fire department connection to mains.
- B. Install protective pipe bollards [**on two sides of**] [**on three sides of**] <Describe arrangement> each fire department connection. Pipe bollards are specified in Section 055000 "Metal Fabrications."

### 3.20 ALARM DEVICE INSTALLATION

- A. General: Comply with NFPA 24 for devices and methods of valve supervision. Underground valves with valve box do not require supervision.
- B. Supervisory Switches: Supervise valves in open position.
  - 1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.
  - 2. Indicator Posts: Drill and thread hole in upper-barrel section at target plate. Install switch, with toggle against target plate, on barrel of indicator post.
- C. Locking and Sealing: Secure unsupervised valves as follows:
  - 1. Valves: Install chain and padlock on open OS&Y gate valve.
  - 2. Post Indicators: Install padlock on wrench on indicator post.
- D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.
- E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.
- F. Connect alarm devices to building fire alarm system. Wiring and fire-alarm devices are specified in Section 284621.11 "Addressable Fire-Alarm Systems" and Section 284621.13 "Conventional Fire-Alarm Systems."

### 3.21 CONNECTIONS

- A. See Section 330500 "Common Work Results for Utilities" for piping connections to valves and equipment.
- B. Connect water-distribution piping to [utility water main] [existing water main] <Insert piping system>. Use [tapping sleeve and tapping valve] [service clamp and corporation valve] <Insert method>.
- C. Connect water-distribution piping to interior [domestic water] [and] [fire-suppression] piping.
- D. Connect waste piping from concrete vault drains to [sanitary sewerage system. See Section 221313 "Facility Sanitary Sewers" for connection to sanitary-sewer] [storm-drainage system. See Section 334400 "Storm Utility Drainage Piping" for connection to storm-sewer] piping.
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.22 FIELD QUALITY CONTROL

- A. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.
- B. Hydrostatic Tests: Test at not less than one-and-one-half times working pressure for two hours.
  - 1. Increase pressure in 50-psig (350-kPa) increments and inspect each joint between increments. Hold at test pressure for 1 hour; decrease to 0 psig (0 kPa). Slowly increase again to test pressure and hold for 1 more hour. Maximum allowable leakage is 2 quarts (1.89 L) per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.
- C. Prepare reports of testing activities.

### 3.23 IDENTIFICATION

- A. Install continuous underground[ detectable] warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Section 312000 "Earth Moving."
- B. Permanently attach equipment nameplate or marker indicating plastic water-service piping, on main electrical meter panel. See Section 330500 "Common Work Results for Utilities" for identifying devices.

## 3.24 CLEANING

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

END OF SECTION 221113

## SECTION 221313 - FACILITY SANITARY SEWERS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless cast-iron soil pipe and fittings.
  - 3. Ductile-iron, gravity sewer pipe and fittings.
  - 4. Ductile-iron, pressure pipe and fittings.
  - 5. ABS pipe and fittings.
  - 6. PVC pipe and fittings.
  - 7. Fiberglass pipe and fittings.
  - 8. Concrete pipe and fittings.
  - 9. Nonpressure-type transition couplings.
  - 10. Pressure-type pipe couplings.
  - 11. Expansion joints and deflection fittings.
  - 12. Backwater valves.
  - 13. Cleanouts.
  - 14. Encasement for piping.
  - 15. Manholes.
  - 16. Concrete.

## 1.3 DEFINITIONS

- A. FRP: Fiberglass-reinforced plastic.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:



1. Pipe and fittings.
2. Non-pressure and pressure couplings
3. Expansion joints and deflection fittings.
4. Backwater valves.
5. Cleanouts.

- B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings:

1. Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from sewer system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.
2. Show system piping in profile. Draw profiles to horizontal scale of not less than **1 inch equals 50 feet (1:500)** and to vertical scale of not less than **1 inch equals 5 feet (1:50)**. Indicate manholes and piping. Show types, sizes, materials, and elevations of other utilities crossing system piping.

- B. Product Certificates: For each type of pipe and fitting.

- C. Field quality-control reports.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Do not store plastic manholes, pipe, and fittings in direct sunlight.
- B. Protect pipe, pipe fittings, and seals from dirt and damage.
- C. Handle manholes according to manufacturer's written rigging instructions.

## 1.7 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:
1. Notify **[Architect]** **[Construction Manager]** **[Owner]** no fewer than **[two]** **<Insert number>** days in advance of proposed interruption of service.
  2. Do not proceed with interruption of service without **[Architect's]** **[Construction Manager's]** **[Owner's]** written permission.

## PART 2 - PRODUCTS

## 2.1 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, [Service class] [Service and Extra-Heavy classes] [and] [Extra-Heavy class].
- B. Gaskets: ASTM C 564, rubber.
- C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

## 2.2 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.
- B. CISPI-Trademark, Shielded Couplings:
  - 1. Description: ASTM C 1277 and CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Heavy-Duty, Shielded Couplings:
  - 1. Description: ASTM C 1277 and ASTM C 1540, with stainless-steel shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Cast-Iron, Shielded Couplings:
  - 1. Description: ASTM C 1277 with ASTM A 48/A 48M, two-piece, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. Unshielded Couplings:
  - 1. Description: ASTM C 1277 and ASTM C 1461, rigid, sleeve-type, reducing- or transition-type mechanical coupling, with integral, center pipe stop, molded from ASTM C 1440, thermoplastic elastomer (TPE) material; with corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.3 DUCTILE-IRON, GRAVITY SEWER PIPE AND FITTINGS

- A. Pipe: ASTM A 746, for push-on joints.
- B. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.

- C. Compact Fittings: AWWA C153/A21.53, ductile iron, for push-on joints.
- D. Gaskets: AWWA C111/A21.11, rubber.

## 2.4 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS

### A. Push-on-Joint Piping:

1. Pipe: AWWA C151/A21.51.
2. Standard Fittings: AWWA C110/A21.10, ductile or gray iron.
3. Compact Fittings: AWWA C153/A21.53.
4. Gaskets: AWWA C111/A21.11, rubber, of shape matching pipe and fittings.

### B. Mechanical-Joint Piping:

1. Pipe: AWWA C151/A21.51, with bolt holes in bell.
2. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, with bolt holes in bell.
3. Compact Fittings: AWWA C153/A21.53, with bolt holes in bells.
4. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.
5. Gaskets: AWWA C111/A21.11, rubber, of shape matching pipe, fittings, and glands.

## 2.5 ABS PIPE AND FITTINGS

### A. ABS Sewer Pipe and Fittings: ASTM D 2661, with bell-and-spigot ends for gasketed joints.

1. NPS 3 to NPS 6 (DN 80 to DN 150): SDR 35.
2. NPS 8 to NPS 12 (DN 200 to DN 300): SDR 42.

### B. Gaskets: ASTM F 477, elastomeric seals.

## 2.6 PVC PIPE AND FITTINGS

### A. PVC Cellular-Core Sewer Piping:

1. Pipe: ASTM F 891, Sewer and Drain Series, PS 50 minimum stiffness, PVC cellular-core pipe with plain ends for solvent-cemented joints.
2. Fittings: ASTM D 3034, [SDR 35] <Insert SDR>, PVC socket-type fittings.

### B. PVC Corrugated Sewer Piping:

1. Pipe: ASTM F 949, PVC corrugated pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM F 949, PVC molded or fabricated, socket type.
3. Gaskets: ASTM F 477, elastomeric seals.

### C. PVC Profile Sewer Piping:

1. Pipe: ASTM F 794, PVC profile, gravity sewer pipe with bell-and-spigot ends for gasketed joints.

2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

D. PVC Type PSM Sewer Piping:

1. Pipe: ASTM D 3034, **[SDR 35]** <Insert SDR>, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D 3034, PVC with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

E. PVC Gravity Sewer Piping:

1. Pipe and Fittings: ASTM F 679, **[T-1]** **[T-2]** wall thickness, PVC gravity sewer pipe with bell-and-spigot ends and with integral ASTM F 477, elastomeric seals for gasketed joints.

F. PVC Pressure Piping:

1. Pipe: AWWA C900, **[Class 100]** **[Class 150]** **[and]** **[Class 200]** PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, **[Class 100]** **[Class 150]** **[and]** **[Class 200]** PVC pipe with bell ends.
3. Gaskets: ASTM F 477, elastomeric seals.

G. PVC Water-Service Piping:

1. Pipe: ASTM D 1785, **[Schedule 40]** **[and]** **[Schedule 80]** PVC, with plain ends for solvent-cemented joints.
2. Fittings: **[ASTM D 2466, Schedule 40]** **[and]** **[ASTM D 2467, Schedule 80]** PVC, socket type.

## 2.7 FIBERGLASS PIPE AND FITTINGS

A. Fiberglass Sewer Pipe: ASTM D 3262, RTRP, for gasketed joints fabricated with **[Type 2, polyester]** **[or]** **[Type 4, epoxy]** resin.

1. Liner: **[Reinforced thermoset]** **[Nonreinforced thermoset]** **[Thermoplastic]** **[No liner]**.
2. Grade: **[Reinforced, surface layer matching pipe resin]** **[Nonreinforced, surface layer matching pipe resin]** **[No surface layer]** <Insert grade>.
3. Stiffness: **[9 psig (62 kPa)]** **[18 psig (124 kPa)]** **[36 psig (248 kPa)]** **[72 psig (496 kPa)]**.

B. Fiberglass Nonpressure Fittings: ASTM D 3840, RTRF, for gasketed joints.

1. Laminating Resin: **[Type 1, polyester]** **[or]** **[Type 2, epoxy]** resin.
2. Reinforcement: Grade with finish compatible with resin.

C. Gaskets: ASTM F 477, elastomeric seals.

## 2.8 CONCRETE PIPE AND FITTINGS

- A. Nonreinforced-Concrete Sewer Pipe and Fittings: **ASTM C 14 (ASTM C 14M)**, [**Class 1**] [**Class 2**] [**Class 3**], with [**bell-and-spigot**] [**or**] [**tongue-and-groove**] ends for gasketed joints with **ASTM C 443 (ASTM C 443M)**, rubber gaskets.
- B. Reinforced-Concrete Sewer Pipe and Fittings: **ASTM C 76 (ASTM C 76M)**.
  - 1. [**Bell-and-spigot**] [**or**] [**tongue-and-groove**] ends for gasketed joints, with **ASTM C 443 (ASTM C 443M)**, rubber gaskets.
  - 2. Class II, [**Wall A**] [**Wall B**] [**Wall C**].
  - 3. Class III, [**Wall A**] [**Wall B**] [**Wall C**].
  - 4. Class IV, [**Wall A**] [**Wall B**] [**Wall C**].
  - 5. Class V, [**Wall A**] [**Wall B**].

## 2.9 NONPRESSURE-TYPE TRANSITION COUPLINGS

- A. Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.
- B. Sleeve Materials:
  - 1. For Cast-Iron Soil Pipes: ASTM C 564, rubber.
  - 2. For Concrete Pipes: **ASTM C 443 (ASTM C 443M)**, rubber.
  - 3. For Fiberglass Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 4. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
  - 5. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
- C. Unshielded, Flexible Couplings:
  - 1. Description: Elastomeric sleeve with[ **stainless-steel shear ring and**] corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Shielded, Flexible Couplings:
  - 1. Description: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. Ring-Type, Flexible Couplings:
  - 1. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.
  - 2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- F. Nonpressure-Type, Rigid Couplings:

1. Description: ASTM C 1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C 1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.10 PRESSURE-TYPE PIPE COUPLINGS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Tubular-Sleeve Couplings: AWWA C219, with center sleeve, gaskets, end rings, and bolt fasteners.
- C. Metal, bolted, sleeve-type, reducing or transition coupling; for joining underground pressure piping. Include [150-psig (1035-kPa)] [200-psig (1380-kPa)] <Insert value> minimum pressure rating and ends of same sizes as piping to be joined.
- D. Center-Sleeve Material: [Manufacturer's standard] [Carbon steel] [Stainless steel] [Ductile iron] [Malleable iron].
- E. Gasket Material: Natural or synthetic rubber.
- F. Metal Component Finish: Corrosion-resistant coating or material.

## 2.11 EXPANSION JOINTS AND DEFLECTION FITTINGS

- A. Ductile-Iron, Flexible Expansion Joints:
  1. Description: Compound fitting with combination of flanged and mechanical-joint ends complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250-psig (1725-kPa) minimum working pressure and for offset and expansion indicated.
  2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Ductile-Iron Expansion Joints:
  1. Description: Three-piece assembly of telescoping sleeve with gaskets and restrained-type, ductile-iron, bell-and-spigot end sections complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include rating for 250-psig (1725-kPa) minimum working pressure and for expansion indicated.
  2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Ductile-Iron Deflection Fittings:
  1. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends complying with AWWA C110/A21.10 or AWWA C153/A21.53. Include rating for 250-psig (1725-kPa) minimum working pressure and for up to 15 degrees of deflection.
  2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.12 BACKWATER VALVES

### A. Cast-Iron Backwater Valves:

1. Description: ASME A112.14.1, gray-iron body and bolted cover, with bronze seat.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
3. Horizontal type; with swing check valve and hub-and-spigot ends.
4. Combination horizontal and manual gate-valve type; with swing check valve, integral gate valve, and hub-and-spigot ends.
5. Terminal type; with bronze seat, swing check valve, and hub inlet.

### B. PVC Backwater Valves:

1. Description: Horizontal type; with PVC body, PVC removable cover, and PVC swing check valve.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.13 CLEANOUTS

### A. Cast-Iron Cleanouts:

1. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
3. Top-Loading Classification(s): [**Light Duty**] [**Medium Duty**] [**Heavy Duty**] [**and**] [**Extra-Heavy Duty**].
4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

### B. PVC Cleanouts:

1. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.14 ENCASUREMENT FOR PIPING

A. Standard: ASTM A 674 or AWWA C105/A21.5.

B. Material: [**Linear low-density polyethylene film of 0.008-inch (0.20-mm)**] [**or**] [**high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)**] minimum thickness.

C. Form: [**Sheet**] [**or**] [**tube**].

D. Color: [**Black**] [**or**] [**natural**] <Insert color>.

## 2.15 MANHOLES

## A. Standard Precast Concrete Manholes:

1. Description: **ASTM C 478 (ASTM C 478M)**, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
2. Diameter: **48 inches (1200 mm)** minimum unless otherwise indicated.
3. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
4. Base Section: **6-inch (150-mm)** minimum thickness for floor slab and **4-inch (100-mm)** minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
5. Riser Sections: **4-inch (100-mm)** minimum thickness, of length to provide depth indicated.
6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
7. Joint Sealant: **ASTM C 990 (ASTM C 990M)**, bitumen or butyl rubber.
8. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
9. Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP**] [**ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP**] <Insert material>; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than [**60 inches (1500 mm)**] <Insert dimension>.
10. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
11. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

## B. Designed Precast Concrete Manholes:

1. Description: **ASTM C 913**; designed according to **ASTM C 890** for A-16 (ASSHTO HS20-44 in AASHTO HL), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for sealant joints.
2. Ballast: Increase thickness of one or more precast concrete sections or add concrete to manhole as required to prevent flotation.
3. Joint Sealant: **ASTM C 990 (ASTM C 990M)**, bitumen or butyl rubber.
4. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
5. Steps: [**Individual FRP steps or FRP ladder**] [**Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP**] [**ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP**] <Insert material>; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals.



Omit steps if total depth from floor of manhole to finished grade is less than [**60 inches (1500 mm)**] <Insert dimension>.

6. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
7. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

C. Fiberglass Manholes:

1. Description: ASTM D 3753.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
3. Diameter: **48 inches (1200 mm)** minimum unless otherwise indicated.
4. Ballast: Increase thickness of concrete base as required to prevent flotation.
5. Base Section: Concrete, **6-inch (150-mm)** minimum thickness.
6. Resilient Pipe Connectors: **ASTM C 923 (ASTM C 923M)**, cast or fitted into manhole walls, for each pipe connection.
7. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at **12- to 16-inch (300- to 400-mm)** intervals. Omit steps if total depth from floor of manhole to finished grade is less than [**60 inches (1500 mm)**] <Insert dimension>.
8. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
9. Grade Rings: Reinforced-concrete rings, **6- to 9-inch (150- to 225-mm)** total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

D. Manhole Frames and Covers:

1. Description: Ferrous; **24-inch (610-mm)** ID by **7- to 9-inch (175- to 225-mm)** riser, with **4-inch- (100-mm-)** minimum-width flange and **26-inch- (660-mm-)** diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: [**ASTM A 536, Grade 60-40-18 ductile**] [**ASTM A 48/A 48M, Class 35 gray**] iron unless otherwise indicated.

E. Manhole-Cover Inserts:

1. Description; Manufactured, plastic form, of size to fit between manhole frame and cover and designed to prevent stormwater inflow. Include handle for removal and gasket for gastight sealing.
2. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
3. Type: [**Solid**] [**Drainage with vent holes**] [**Valve**].

## 2.16 CONCRETE

- A. General: Cast-in-place concrete complying with ACI 318, **ACI 350 (ACI 350M)**, and the following:
1. Cement: ASTM C 150/C 150M, Type II.
  2. Fine Aggregate: ASTM C 33/C 33M, sand.
  3. Coarse Aggregate: ASTM C 33/C 33M, crushed gravel.
  4. Water: Potable.
- B. Portland Cement Design Mix: **4000 psi (27.6 MPa)** minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A 1064/A 1064M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (420-MPa)** deformed steel.
- C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, **4000 psi (27.6 MPa)** minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
    - a. Invert Slope: **[1] [2]** percent through manhole.
  2. Benches: Concrete, sloped to drain into channel.
    - a. Slope: **[4] [8]** percent.
- D. Ballast and Pipe Supports: Portland cement design mix, **3000 psi (20.7 MPa)** minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A1064/A 1064M, steel, welded wire fabric, plain.
  2. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (420-MPa)** deformed steel.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

- B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. Install manholes for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.
- D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.
- E. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.
- F. Install gravity-flow, nonpressure, drainage piping according to the following:
1. Install piping pitched down in direction of flow, at minimum slope of [1] [2] <Insert number> percent unless otherwise indicated.
  2. Install piping [NPS 6 (DN 150)] <Insert pipe size> and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
  3. Install piping with [36-inch (915-mm)] [48-inch (1220-mm)] [60-inch (1520-mm)] [72-inch (1830-mm)] <Insert dimension> minimum cover.
  4. Install hub-and-spigot, cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  5. Install hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
  6. Install ductile-iron, gravity sewer piping according to ASTM A 746.
  7. Install ABS sewer piping according to ASTM D 2321 and ASTM F 1668.
  8. Install PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 1668.
  9. Install PVC corrugated sewer piping according to ASTM D 2321 and ASTM F 1668.
  10. Install PVC profile sewer piping according to ASTM D 2321 and ASTM F 1668.
  11. Install PVC Type PSM sewer piping according to ASTM D 2321 and ASTM F 1668.
  12. Install PVC gravity sewer piping according to ASTM D 2321 and ASTM F 1668.
  13. Install fiberglass sewer piping according to ASTM D 3839 and ASTM F 1668.
  14. Install nonreinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
  15. Install reinforced-concrete sewer piping according to ASTM C 1479 and ACPA's "Concrete Pipe Installation Manual."
- G. Install force-main, pressure piping according to the following:
1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
  2. Install piping with [36-inch (915-mm)] [48-inch (1220-mm)] [60-inch (1520-mm)] [72-inch (1830-mm)] <Insert dimension> minimum cover.
  3. Install ductile-iron pressure piping according to AWWA C600 or AWWA M41.
  4. Install ductile-iron special fittings according to AWWA C600.
  5. Install PVC pressure piping according to AWWA M23 or to ASTM D 2774 and ASTM F 1668.

6. Install PVC water-service piping according to ASTM D 2774 and ASTM F 1668.
- H. Install corrosion-protection piping encasement over the following underground metal piping according to ASTM A 674 or AWWA C105/A21.5:
  1. Hub-and-spigot, cast-iron soil pipe.
  2. Hubless cast-iron soil pipe and fittings.
  3. Ductile-iron pipe and fittings.
  4. Expansion joints and deflection fittings.
- I. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

### 3.3 PIPE JOINT CONSTRUCTION

- A. Join gravity-flow, nonpressure, drainage piping according to the following:
  1. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
  2. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
  3. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
  4. Join ductile-iron, gravity sewer piping according to AWWA C600 for push-on joints.
  5. Join ABS sewer piping according to ASTM D 2321 for elastomeric-seal joints.
  6. Join PVC cellular-core sewer piping according to ASTM D 2321 and ASTM F 891 for solvent-cemented joints.
  7. Join PVC corrugated sewer piping according to ASTM D 2321.
  8. Join PVC profile sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
  9. Join PVC Type PSM sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
  10. Join PVC gravity sewer piping according to ASTM D 2321 and ASTM D 3034 for elastomeric-seal joints or ASTM D 3034 for elastomeric-gasket joints.
  11. Join fiberglass sewer piping according to ASTM D 4161 for elastomeric-seal joints.
  12. Join nonreinforced-concrete sewer piping according to **ASTM C 14 (ASTM C 14M)** and ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
  13. Join reinforced-concrete sewer piping according to ACPA's "Concrete Pipe Installation Manual" for rubber-gasket joints.
  14. Join dissimilar pipe materials with nonpressure-type, flexible[ **or rigid**] couplings.
- B. Join force-main, pressure piping according to the following:
  1. Join ductile-iron pressure piping according to AWWA C600 or AWWA M41 for push-on joints.
  2. Join ductile-iron special fittings according to AWWA C600 or AWWA M41 for push-on joints.
  3. Join PVC pressure piping according to AWWA M23 for gasketed joints.
  4. Join PVC water-service piping according to ASTM D 2855.

5. Join dissimilar pipe materials with pressure-type couplings.
- C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
    - a. **[Unshielded]** **[Shielded]** flexible **[ or rigid]** couplings for pipes of same or slightly different OD.
    - b. Unshielded, increaser/reducer-pattern, flexible **[ or rigid]** couplings for pipes with different OD.
    - c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
  2. Use pressure pipe couplings for force-main joints.

### 3.4 MANHOLE INSTALLATION

- A. General: Install manholes complete with appurtenances and accessories indicated.
- B. Install precast concrete manhole sections with sealants according to ASTM C 891.
- C. Install FRP manholes according to manufacturer's written instructions.
- D. Form continuous concrete channels and benches between inlets and outlet.
- E. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops **[3 inches (76 mm)]** **<Insert dimension>** above finished surface elsewhere unless otherwise indicated.
- F. Install manhole-cover inserts in frame and immediately below cover.

### 3.5 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318.

### 3.6 BACKWATER VALVE INSTALLATION

- A. Install horizontal-type backwater valves in piping manholes or pits.
- B. Install combination horizontal and manual gate-type valves in piping and in manholes.
- C. Install terminal-type backwater valves on end of piping and in manholes. Secure units to sidewalls.

### 3.7 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts, and use cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
1. Use Light-Duty, top-loading classification cleanouts in [**earth or unpaved foot-traffic**] <Insert other> areas.
  2. Use Medium-Duty, top-loading classification cleanouts in [**paved foot-traffic**] <Insert other> areas.
  3. Use Heavy-Duty, top-loading classification cleanouts in [**vehicle-traffic service**] <Insert other> areas.
  4. Use Extra-Heavy-Duty, top-loading classification cleanouts in [**roads**] <Insert area>.
- B. Set cleanout frames and covers in earth in cast-in-place-concrete block, [**18 by 18 by 12 inches (450 by 450 by 300 mm)**] <Insert dimensions> deep. Set with tops [**1 inch (25 mm)**] <Insert dimension> above surrounding grade.
- C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

### 3.8 CONNECTIONS

- A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."
- B. Connect force-main piping to building's sanitary force mains specified in Section 221316 "Sanitary Waste and Vent Piping." Terminate piping where indicated.
- C. Make connections to existing piping and underground manholes.
1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus **6-inch (150-mm)** overlap with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
  2. Make branch connections from side into existing piping, **NPS 4 to NPS 20 (DN 100 to DN 500)**. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than **6 inches (150 mm)** of concrete with 28-day compressive strength of **3000 psi (20.7 MPa)**.
  3. Make branch connections from side into existing piping, **NPS 21 (DN 525)** or larger, or to underground manholes by cutting opening into existing unit large enough to allow **3 inches (76 mm)** of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of, and be flush with, inside wall unless otherwise indicated. On outside of pipe or manhole wall, encase entering connection in **6 inches (150 mm)** of concrete for minimum length of **12 inches (300 mm)** to provide additional support of collar from connection to undisturbed ground.
    - a. Use concrete that will attain a minimum 28-day compressive strength of **3000 psi (20.7 MPa)** unless otherwise indicated.

- b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.
- 4. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
- D. Connect to **[grease]** **[oil]** **[and]** **[sand]** interceptors specified in Section 221323 "Sanitary Waste Interceptors."

### 3.9 CLOSING ABANDONED SANITARY SEWER SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
  - 1. Close open ends of piping with at least **[8-inch- (203-mm-)]** **<Insert dimension>** thick, brick masonry bulkheads.
  - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
  - 1. Remove manhole and close open ends of remaining piping.
  - 2. Remove top of manhole down to at least **[36 inches (915 mm)]** **<Insert dimension>** below final grade. Fill to within **[12 inches (300 mm)]** **<Insert dimension>** of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.
- C. Backfill to grade according to Section 312000 "Earth Moving."

### 3.10 IDENTIFICATION

- A. Comply with requirements in Section 312000 "Earth Moving" for underground utility identification devices. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
  - 1. Use **[warning tape or]** detectable warning tape over ferrous piping.
  - 2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

### 3.11 FIELD QUALITY CONTROL

- A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately **24 inches (600 mm)** of backfill is in place, and again at completion of Project.
  - 1. Submit separate report for each system inspection.
  - 2. Defects requiring correction include the following:

- a. Alignment: Less than full diameter of inside of pipe is visible between structures.
  - b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
  - c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
  - d. Infiltration: Water leakage into piping.
  - e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
  4. Reinspect and repeat procedure until results are satisfactory.
- B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
  2. Test completed piping systems according to requirements of authorities having jurisdiction.
  3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
  4. Submit separate report for each test.
  5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
    - a. Fill sewer piping with water. Test with pressure of at least 10-foot (3-m) head of water, and maintain such pressure without leakage for at least 15 minutes.
    - b. Close openings in system and fill with water.
    - c. Purge air and refill with water.
    - d. Disconnect water supply.
    - e. Test and inspect joints for leaks.
  6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
    - a. Test plastic gravity sewer piping according to ASTM F 1417.
    - b. Test concrete gravity sewer piping according to ASTM C 1628.
  7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than 1-1/2 times the maximum system operating pressure, but not less than [150 psig (1035 kPa)] <Insert value>.
    - a. Ductile-Iron Piping: Test according to AWWA C600, "Hydraulic Testing" Section.
    - b. PVC Piping: Test according to AWWA M23, "Testing and Maintenance" Chapter.
  8. Manholes: Perform hydraulic test according to ASTM C 969 (ASTM C 969M).
- C. Leaks and loss in test pressure constitute defects that must be repaired.
- D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.



3.12 CLEANING

- A. Clean dirt and superfluous material from interior of piping.[ **Flush with potable water.**]

END OF SECTION 221313

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## SECTION 221323 - SANITARY WASTE INTERCEPTORS

### **TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

Revise this Section by deleting and inserting text to meet Project-specific requirements.

This Section uses the term "Architect." Change this term to match that used to identify the design professional as defined in the General and Supplementary Conditions.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

- 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. Grease interceptors.
  - 2. Grease removal devices.
  - 3. Oil interceptors.
  - 4. Sand interceptors.
  - 5. Solids interceptors.

#### 1.3 DEFINITIONS

Retain terms that remain after this Section has been edited for a project.

- A. FRP: Fiberglass-reinforced plastic.

- B. PP: Polypropylene plastic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of **[metal]** **[and]** **[plastic]** interceptor. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.
- B. Shop Drawings: For each type and size of precast concrete interceptor indicated.
  - 1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

#### 1.5 INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below to require coordination of other trades involved in installations products listed below.

- A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Piping connections. Include size, location, and elevation of each.
  - 2. Interface with underground structures and utility services.

#### 1.6 FIELD CONDITIONS

Retain this article if interruption of existing sanitary or storm sewer service is required.

- A. Interruption of Existing Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:
  - 1. Notify **[Architect]** **[Construction Manager]** **[Owner]** no fewer than **[seven]** **<Insert number>** days in advance of proposed interruption of service.
  - 2. Do not proceed with interruption of sewer services without **[Architect's]** **[Construction Manager's]** **[Owner's]** written permission.

### PART 2 - PRODUCTS

Manufacturers and products listed in SpecAgent and Masterworks Paragraph Builder are neither recommended nor endorsed by the AIA or ARCOM. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

## 2.1 GREASE INTERCEPTORS

Indicate on Drawings the number, size, and arrangement of compartments and baffles in grease interceptors in first paragraph below. Delete option below and insert name of authorities having jurisdiction for interceptors that must comply with requirements of authorities having jurisdiction.

- A. Precast Concrete Grease Interceptors: Comply with [ASTM C 913] <Insert authorities having jurisdiction>.

Delete first subparagraph below if interceptors must comply with requirements of authorities having jurisdiction.

1. Include rubber-gasketed joints, [vent connections, ]manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
  - a. Light-Traffic Load: Comply with ASTM C 890, A-8.
  - b. Medium-Traffic Load: Comply with ASTM C 890, A-12.
  - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16.
  - d. Walkway Load: Comply with ASTM C 890, A-03.

"Resilient Pipe Connectors" Subparagraph below is an optional feature.

3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than [60 inches (1500 mm)] <Insert dimension>.

"Grade Rings" Subparagraph below is an optional feature.

5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.

"Manhole Frames and Covers" Subparagraph below is an optional feature. Underground structures with risers to grade only require manhole frames and covers at top of riser.

6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
  - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
  - b. Gray Iron: ASTM A 48/A 48M, Class 35, unless otherwise indicated.

Lettering in subparagraph below should be simple and must be short enough to fit on cover. Custom lettering costs more than standard lettering such as "INTERCEPTOR" and "SANITARY SEWER."

- c. Include indented top design with lettering cast into cover, using wording equivalent to "[INTERCEPTOR] [GREASE INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."

Copy first paragraph below and re-edit for each product.

Insert drawing designation. Use these designations on Drawings to identify each product.

B. Cast-Iron or Steel Grease Interceptors <Insert drawing designation if any>:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standard: ASME A112.14.3[ **and PDI-G101**], for intercepting and retaining fats, oils, and greases from food[**-preparation**] [or] [**-processing**] wastewater.

PDI certification is currently limited to 50-gpm (3.15-L/s) flow rate and 100-lb (45.4-kg) grease retention by PDI-G101. Larger uncertified units are available.

3. Plumbing and Drainage Institute Seal: [Not required] [Required].
4. Body Material: Cast iron or steel.
5. Interior Lining: [Corrosion-resistant enamel] [Not required] <Insert lining>.
6. Exterior Coating: [Corrosion-resistant enamel] [Not required] <Insert coating>.
7. Body Dimensions: <Insert dimensions>.
8. Body Extension: [Not required] [Required].

C. Plastic Grease Interceptors:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Standard: ASME A112.14.3[ **and PDI-G101**], for intercepting and retaining fats, oils, and greases from food[**-preparation**] [or] [**-processing**] wastewater.

PDI certification is currently limited to 50-gpm (3.15-L/s) flow rate and 100-lb (45.4-kg) grease retention by PDI-G101. Larger uncertified units are available.

3. Plumbing and Drainage Institute Seal: [Not required] [Required].
4. Body Material: Plastic.
5. Body Dimensions: <Insert dimensions>.
6. Body Extension: [Not required] [Required].

If more than one grease interceptor is required, delete "Capacities and Characteristics" Paragraph below and schedule grease interceptors on Drawings.

D. Capacities and Characteristics:

1. Length by Width by Depth: <Insert inches (mm)>.
2. Number of Compartments: [One] [Two] <Insert number>.

Rate in first subparagraph below is limited to 100 gpm (6.3 L/s).

3. Flow Rate: <Insert interceptor design rate>.

Capacity in first subparagraph below is limited to 200 lb (90.7 kg).

4. Retention Capacity: <Insert gal. or lb (L or kg)>.

5. Inlet and Outlet Pipe Size: **<Insert NPS (DN)>**.
  - a. Centerline of Inlet to Floor: **<Insert inches (mm)>**.
  - b. Centerline of Outlet to Floor: **<Insert inches (mm)>**.
6. End Connections: **[Flanged] [Hub] [Threaded]**.
7. Cleanout: Integral **[ or field installed on outlet]**.
8. Trapped Outlet Required: **[Integral] [No] [Yes]**.
9. Vent Pipe Size: **[Not required] <Insert NPS (DN)>**.
10. Mounting: **[Above floor] [Recessed in acid-resistant, coated steel frame and cradle] [Recessed, flush with floor] <Insert mounting>**.
11. Flow-Control Fitting: **[Not required] [Required]**.
12. Operation: **[Automatic recovery] [Manual cleaning] [Semiautomatic, manual drawoff] <Insert operation>**.

## 2.2 GREASE REMOVAL DEVICES

Copy paragraph below and re-edit for each product.

Insert drawing designation. Use these designations on Drawings to identify each product.

- A. Grease Removal Devices **<Insert drawing designation if any>**:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Standard: ASME A112.14.4 **[ and with PDI-G101 for flow tests]**, for automatic intercepting and removal of fats, oils, and greases from food **[-preparation] [or] [-processing]** **<Insert application>** wastewater.

PDI certification is currently limited to 50-gpm (3.15-L/s) flow rate and 100-lb (45.4-kg) grease retention by PDI-G101. Larger uncertified units are available.

3. Body Material: **[Stainless steel] [Steel] <Insert material>**.
4. Interior Separation Device: **[Baffles] [Screens] <Insert device>**.
5. Heater: **[Not required] [Required]**.
6. Interior Lining: **[Not required] <Insert description if required>**.
7. Exterior Coating: **[Not required] <Insert description if required>**.
8. Unit Dimensions: **<Insert dimensions>**.
9. Flow Rate: **<Insert recovery unit design rate>**.
10. Basket Material: **[Stainless steel] <Insert material>**.
11. Inlet and Outlet Size: **<Insert size>**.
12. End Connections: **[Flanged] [Hub] [Threaded]**.
13. Cleanout: Integral **[ or field installed on outlet]**.
14. Mounting: **[Above floor] <Insert mounting>**.
15. Flow-Control Fitting: **[Not required] [Required]**.
16. Operation: **[Automatic recovery] <Insert operation>**.
17. Power Requirement: **[120-V ac] <Insert power>**.
18. Full-Load Amperes: **<Insert value> A**.
19. Minimum Circuit Ampacity: **<Insert value> A**.
20. Maximum Overcurrent Protection: **<Insert value> A**.
21. Waste Grease Receptacle: **[Furnished by Owner] <Insert description>**.

## 2.3 OIL INTERCEPTORS

Indicate on Drawings the number, size, and arrangement of compartments and baffles in oil interceptors in first paragraph below. Delete option below and insert name of authorities having jurisdiction for interceptors complying with requirements of authorities having jurisdiction.

- A. Precast Concrete Oil Interceptors: Comply with [ASTM C 913] <Insert authorities having jurisdiction>.

Delete first subparagraph below if interceptors must comply with requirements of authorities having jurisdiction.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain grease and to permit wastewater flow.
2. Structural Design Loads:
  - a. Light-Traffic Load: Comply with ASTM C 890, A-8.
  - b. Medium-Traffic Load: Comply with ASTM C 890, A-12.
  - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16.
  - d. Walkway Load: Comply with ASTM C 890, A-03.

"Resilient Pipe Connectors" Subparagraph below is an optional feature.

3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than [60 inches (1500 mm)] <Insert dimension>.

"Grade Rings" Subparagraph below is an optional feature.

5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.

"Manhole Frames and Covers" Subparagraph below is an optional feature. Underground structures with risers to grade only require manhole frames and covers at top of riser.

6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
  - a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
  - b. Gray Iron: ASTM A 48/A 48M, Class 35, unless otherwise indicated.

Lettering in first subparagraph below should be simple and must be short enough to fit on cover. Custom lettering costs more than standard lettering such as "INTERCEPTOR" and "SANITARY SEWER."

- c. Include indented top design with lettering cast into cover, using wording equivalent to "[INTERCEPTOR] [OIL INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."
7. Waste-oil storage tank and piping are specified in Section 231113 "Facility Fuel-Oil Piping."

Coordinate "Cast-Iron or Steel Oil Interceptors" and "Plastic Oil Interceptors" paragraphs below with Section 231113 "Facility Fuel-Oil Piping" for waste-oil storage tanks and oil and vent piping.

- B. Cast-Iron or Steel Oil Interceptors: Factory-fabricated; with removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: Hub, hubless, or threaded, unless otherwise indicated.

"Extension" Subparagraph below is an optional feature. Retain only if required. Verify availability.

3. Extension: Cast-iron or steel shroud, full size of interceptor, extending from top of interceptor to grade.
  4. Cover: Cast iron or steel, with steel reinforcement to provide ASTM C 890, [A-03, walkway] <Insert loading type> load.
  5. Comply with requirements in Section 231113 "Facility Fuel-Oil Piping" for waste-oil storage tank and piping.
- C. Plastic Oil Interceptors: Removable sediment bucket or strainer, baffles, vents, and flow-control fitting on inlet.
    1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
    2. Inlet, Outlet, Vent, and Waste-Oil Outlet Piping Connections: Hub, hubless, or threaded, unless otherwise indicated.

"Extension" Subparagraph below is an optional feature. Verify availability.

3. Extension: Plastic shroud, full size of interceptor, extending from top of interceptor to grade.
4. Cover: Plastic[ with steel reinforcement to provide ASTM C 890,] [A-03, walkway] <Insert loading type> load.
5. Waste-oil storage tank and piping are specified in Section 231113 "Facility Fuel-Oil Piping."

If more than one oil interceptor is required, delete "Capacities and Characteristics" Paragraph below and schedule oil interceptors on Drawings.

- D. Capacities and Characteristics:
  1. Capacity: [Not applicable] <Insert gal. (L)>.
  2. Overall Dimensions: <Insert inches (mm)>.
  3. Flow Rate: <Insert interceptor design rate>.
  4. Inlet and Outlet Pipe Size: <Insert NPS (DN)>.



- a. Centerline of Inlet to Floor: <Insert inches (mm)>.
  - b. Centerline of Outlet to Floor: <Insert inches (mm)>.
- 5. End Connections: [Flanged] [Hub] [Threaded].
  - 6. Waste-Oil-Outlet Pipe Size: <Insert NPS (DN)>.
    - a. Centerline of Outlet to Floor: <Insert inches (mm)>.
  - 7. Trapped Outlet Required: [Integral] [No] [Yes].
  - 8. Cleanout: Integral[ or field installed on outlet].
  - 9. Vent Pipe Size: <Insert NPS (DN)>.
  - 10. Mounting: [Above floor] [Recessed in acid-resistant, coated steel frame and cradle] [Recessed, flush with floor] <Insert mounting>.
  - 11. Flow-Control Fitting: [Not required] [Required].

## 2.4 SAND INTERCEPTORS

Sand interceptors in "Description" Paragraph below are small and intended for shallow installation in locations such as outdoor showers.

- A. Description: Factory-fabricated, cast-iron or steel body and inlet grate; with settlement chamber and removable basket or strainer.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Outlet Piping Connection: Hub, hubless, or threaded, unless otherwise indicated.
- D. Grate: Cast iron or steel with reinforcement to provide ASTM C 890, [A-03, walkway] <Insert loading type> load.

If more than one sand interceptor is required, delete "Capacities and Characteristics" Paragraph below and schedule sand interceptors on Drawings.

- E. Capacities and Characteristics:
  - 1. Capacity: [Not applicable] <Insert gal. (L)>.
  - 2. Overall Dimensions: <Insert inches (mm)>.
  - 3. Outlet Pipe Size: <Insert NPS (DN)>.
  - 4. Trapped Outlet Required: [Integral] [No] [Yes].
  - 5. Vent Pipe Size: [Not required] <Insert NPS (DN)>.
  - 6. Installation Position: [Top flush with grade] <Insert position>.

## 2.5 SOLIDS INTERCEPTORS

Copy first paragraph below and re-edit for each product.

Insert drawing designation. Use these designations on Drawings to identify each product.

- A. Cast-Iron or Steel Solids Interceptors <Insert drawing designation if any>:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Type: Factory-fabricated interceptor made for removing and retaining [**lint**] [**sediment**] **<Insert solid>** from wastewater.
3. Body Material: Cast iron or steel.
4. Interior Separation Device: [**Baffles**] [**Screens**] **<Insert device>**.
5. Interior Lining: [**Corrosion-resistant enamel**] [**Not required**] **<Insert lining>**.
6. Exterior Coating: [**Corrosion-resistant enamel**] [**Not required**] **<Insert coating>**.
7. Body Dimensions: **<Insert dimensions>**.
8. Flow Rate: [**Not required**] **<Insert description if required>**.
9. Inlet and Outlet Size: **<Insert size>**.
10. End Connections: [**Threaded**] **<Insert connections>**.
11. Mounting: [**Above floor**] [**Inline**] **<Insert mounting>**.

B. Plastic Solids Interceptors:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Type: Factory-fabricated interceptor made for removing and retaining [**lint**] [**sediment**] **<Insert solid>** from wastewater.
3. Body Material: Plastic.
4. Interior Separation Device: [**Baffles**] [**Screens**] **<Insert device>**.
5. Body Dimensions: **<Insert dimensions>**.
6. Flow Rate: [**Not required**] **<Insert description if required>**.
7. Inlet and Outlet Size: **<Insert size>**.
8. End Connections: [**Threaded**] **<Insert connections>**.
9. Mounting: [**Above floor**] [**Inline**] **<Insert mounting>**.

## 2.6 PRECAST CONCRETE MANHOLE RISERS

Retain this article for manhole risers for underground concrete interceptors to provide access from grade level to interior of interceptors.

- A. Precast Concrete Manhole Risers: [**ASTM C 478 (ASTM C 478M)**] [**ASTM C 913**], with rubber-gasket joints.
  1. Structural Design Loads:
    - a. Light-Traffic Load: Comply with ASTM C 890, A-8.
    - b. Medium-Traffic Load: Comply with ASTM C 890, A-12.
    - c. Heavy-Traffic Load: Comply with ASTM C 890, A-16.
    - d. Walkway Load: Comply with ASTM C 890, A-03.
  2. Length: From top of underground concrete structure to grade.
  3. Riser Sections: **3-inch (75-mm)** minimum thickness and [**36-inch (915-mm)**] **<Insert dimension>** diameter.
  4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
  5. Gaskets: **ASTM C 443 (ASTM C 443M)**, rubber.

6. Steps: [Individual FRP steps or FRP ladder] [Individual FRP steps, FRP ladder, or ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] [ASTM A 615/A 615M, deformed, 1/2-inch (13-mm) steel reinforcing rods encased in ASTM D 4101, PP] <Insert material>, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals.
- B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

Retain "Manhole Frames and Covers" Paragraph below only if required. Underground structures with risers to grade only require manhole frames and covers at top of riser.

- C. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
  1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
  2. Gray Iron: ASTM A 48/A 48M, Class 35, unless otherwise indicated.
  3. Include indented top design with lettering cast into cover, using wording equivalent to the following:

Lettering in two subparagraphs below should be simple and must be short enough to fit on cover. Custom lettering costs more than standard lettering such as "INTERCEPTOR" and "SANITARY SEWER."

- a. Grease Interceptors in Sanitary Sewerage System: "[INTERCEPTOR] [GREASE INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."
- b. Oil Interceptors in Sanitary Sewerage System: "[INTERCEPTOR] [OIL INTERCEPTOR] [SANITARY SEWER] <Insert lettering>."

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

### 3.2 INSTALLATION

- A. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

1. Install [grease interceptors] [grease removal devices] [and] [solids interceptors] on cast-in-place concrete equipment base(s).
2. Comply with requirements for equipment bases and foundations specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."]

- B. Install precast concrete interceptors according to ASTM C 891.
- C. Set interceptors level and plumb.
- D. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.
- E. Set tops of manhole frames and covers flush with finished surface in pavements.
  - 1. Set tops [**3 inches (75 mm)**] <Insert dimension> above finish surface elsewhere unless otherwise indicated.
- F. Set tops of grating frames and grates flush with finished surface.
- G. Set [**metal**] [**and**] [**plastic**] interceptors level and plumb.
- H. Set tops of metal interceptor covers flush with finished surface in pavements.
  - 1. Set tops [**3 inches (75 mm)**] <Insert dimension> above finish surface elsewhere unless otherwise indicated.
- I. Install piping and oil storage tanks according to Section 231113 "Facility Fuel-Oil Piping."
- J. Install grease interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.

Retain one or more of first three subparagraphs below.

- 1. Above-Floor Installation: Set unit with bottom resting on floor unless otherwise indicated.
  - 2. Flush with Floor Installation: Set unit and extension, if required, with cover flush with finished floor.
  - 3. Recessed Floor Installation: Set unit in receiver housing having bottom or cradle supports, with receiver housing cover flush with finished floor.
  - 4. Install cleanout immediately downstream from interceptors not having integral cleanout on outlet.
- K. Install grease removal devices on floor. Install trap, vent, and flow-control fitting according to authorities having jurisdiction.
    - 1. Install control panel adjacent to unit unless otherwise indicated.
  - L. Install oil interceptors, including trapping, venting, and flow-control fitting, according to authorities having jurisdiction and with clear space for servicing.
    - 1. Coordinate oil-interceptor storage tank and gravity drain with Section 231113 "Facility Fuel-Oil Piping."
  - M. Install solids interceptors with cleanout immediately downstream from interceptors that do not have integral cleanout on outlet.

1. Install trap on interceptors that do not have integral trap and are connected to sanitary drainage and vent systems.

### 3.3 CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

- A. Piping installation requirements are specified in Section 221316 "Sanitary Waste and Vent Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Make piping connections between interceptors and piping systems.

### 3.4 IDENTIFICATION

- A. Identification materials and installation are specified in Section 312000 "Earth Moving."
  1. Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.
  2. Use warning tapes or detectable warning tape over ferrous piping.
  3. Use detectable warning tape over nonferrous piping and over edges of underground structures.
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  1. Grease interceptors.
  2. Grease removal devices.
  3. Oil interceptors.
  4. Solids interceptors.

### 3.5 PROTECTION

- A. Protect sanitary waste interceptors from damage during construction period.
- B. Repair damage to adjacent materials caused by sanitary waste interceptor installation.

END OF SECTION 221323

## SECTION 270526 - GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding rods.
  - 5. Grounding labeling.

## 1.3 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. [<Double click to insert sustainable design text for lead content.>](#)

- C. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
  - 1. Ground rods.
  - 2. Ground and roof rings.
  - 3. BCT, TMGB, TGBs, and routing of their bonding conductors.
- B. Qualification Data: For [**Installer**], installation supervisor, and field inspector.
- C. Qualification Data: For testing agency and testing agency's field supervisor.
- D. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test, measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.
    - c. <**Insert field quality-control test results**>.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of ITS [**Technician**] [**Level 2 Installer**], who shall be present at all times when Work of this Section is performed at Project site.
  - 2. Field Inspector: Currently registered by BICSI as [**a designer RCDD**] [**Technician**] to perform the on-site inspection.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

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

- B. Comply with UL 467 for grounding and bonding materials and equipment.
- C. Comply with TIA-607-B.

## 2.2 CONDUCTORS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
  - 2. Cable Tray Equipment Grounding Wire: **[No. 8] [No. 6]** AWG.
  - 3. [<Double click to insert sustainable design text for lead content.>](#)
- D. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG and not longer than **12 inches (300 mm)**. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
  - 2. Not smaller than No. 10 AWG and not longer than **12 inches (300 mm)**. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: **28 kcmils (14.2 sq. mm)**, 14 strands of No. 17 AWG conductor, and **1/4 inch (6.3 mm)** in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; **1-5/8 inches (41 mm)** wide and **1/16 inch (1.6 mm)** thick.

## 2.3 CONNECTORS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.



1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Busbar Connectors: Cast silicon bronze, solderless **[compression]** **[or]** **[exothermic]**-type, mechanical connector; with a long barrel and two holes spaced on **5/8- or 1-inch (15.8- or 25.4-mm)** centers for a two-bolt connection to the busbar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING BUSBARS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, **[1/4 by 4 inches (6.3 by 100 mm)]** **<Insert dimensions>** in cross section, length as indicated on Drawings. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
  1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide a **[4-inch (100-mm)]** **<Insert dimension>** clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, **[1/4 by 2 inches (6.3 by 50 mm)]** **<Insert dimensions>** in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
  1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide at least a **2-inch (50-mm)** clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with TIA-607-B. Predrilling shall be with holes for use with lugs specified in this Section.
  1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
  2. Rack-Mounted Horizontal Busbar: Designed for mounting in **19- or 23-inch (483- or 584-mm)** equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.

3. Rack-Mounted Vertical Busbar: **72 or 36 inches (1827 or 914 mm)** long, with stainless-steel or copper-plated hardware for attachment to the rack.

## 2.5 GROUND RODS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Ground Rods: [**Copper-clad**] [**Zinc-coated**] [**Stainless-**] steel[, **sectional type**]; [**3/4 inch by 10 feet (19 mm by 3 m)**] [**5/8 by 96 inches (16 by 2400 mm)**] in diameter.

## 2.6 IDENTIFICATION

- A. Comply with requirements for identification products in Section 270553 "Identification for Communications Systems."

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.

## 3.3 APPLICATION

- A. Conductors: Install solid conductor for [**No. 8**] **<Insert number>** AWG and smaller and stranded conductors for [**No. 6**] **<Insert number>** AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than [No. 6] <Insert number> AWG.
  2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than [No. 6] <Insert number> AWG.
- B. Underground Grounding Conductors: Install bare [tinned-]copper conductor, [No. 2] <Insert number> AWG minimum.
- C. Conductor Terminations and Connections:
1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  3. Connections to Ground Rods at Test Wells: Bolted connectors.
  4. Connections to Structural Steel: Welded connectors.
- D. Conductor Support:
1. Secure grounding and bonding conductors at intervals of not less than 36 inches (900 mm).
- E. Grounding and Bonding Conductors:
1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
  2. Install without splices.
  3. Support at not more than 36-inch (900-mm) intervals.
  4. Install grounding and bonding conductors in 3/4-inch (21-mm) PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
    - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 270528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

### 3.4 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than [No. 1/0] [No. 3/0] <Insert number> AWG.

### 3.5 GROUNDING BUSBARS

- A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (300 mm) above finished floor unless otherwise indicated.

- B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

### 3.6 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than [No. 6] <Insert number> AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.
- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
  - 1. Use crimping tool and the die specific to the connector.
  - 2. Pretwist the conductor.
  - 3. Apply an antioxidant compound to all bolted and compression connections.
- D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
- E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot (1 sq. mm/linear meter) of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
- F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install [top-mounted] [vertically mounted] rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
- G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
- H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
- I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
- J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
- K. Access Floors: Bond all metal parts of access floors to the TGB.

- L. Equipment Room Signal Reference Grid: Provide a low-impedance path between telecommunications cabinets, equipment racks, and the reference grid, using [No. 6] <Insert number> AWG bonding conductors.
1. Install the conductors in grid pattern on 4-foot (1200-mm) centers, allowing bonding of one pedestal from each access floor tile.
  2. Bond the TGB of the equipment room to the reference grid at two or more locations.
  3. Bond all conduits and piping entering the equipment room to the TGB at the perimeter of the room.
- M. Towers and Antennas:
1. Ground Ring: Buried at least 30 inches (760 mm) below grade and at least 24 inches (610 mm) from the base of the tower or mounting.
  2. Bond each tower base and metallic frame of a dish to the ground ring, buried at least 18 inches (460 mm) below grade.
  3. Bond the ground ring and antenna grounds to the equipment room TMGB or TGB, buried at least 30 inches (760 mm) below grade.
  4. Bond metallic fences within 6 feet (1.8 m) of towers and antennas to the ground ring, buried at least 18 inches (460 mm) below grade.
  5. Special Requirements for Roof-Mounted Towers:
    - a. Roof Ring: Meet requirements for the ground ring except the conductors shall comply with requirements in Section 264113 "Lightning Protection for Structures."
    - b. Bond tower base footings steel, the TGB in the equipment room, and antenna support guys to the roof ring.
    - c. Connect roof ring to the perimeter conductors of the lightning protection system.
  6. Waveguides and Coaxial Cable:
    - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
    - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.
- N. <Insert connections of other equipment>.

### 3.7 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.
- B. Comply with IEEE C2 grounding requirements.
- C. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) extends above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive

insulating tape or heat-shrunk insulating sleeve from **2 inches (50 mm)** above to **6 inches (150 mm)** below concrete. Seal floor opening with waterproof, nonshrink grout.

- D. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect grounding conductors to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

### 3.8 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
  3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.9 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

- a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB[ **and in each TGB**]. Maximum acceptable ac current level is 1 A.
- D. Excessive Ground Resistance: If resistance to ground at the BCT exceeds [5] <Insert value> ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- E. Grounding system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

END OF SECTION 270526

## SECTION 270528 - PATHWAYS FOR COMMUNICATIONS SYSTEMS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Nonmetallic surface pathways.
8. Tele-power poles.
9. Hooks.
10. Boxes, enclosures, and cabinets.
11. Polymer-concrete handholes and boxes for exterior underground cabling.
12. Fiberglass handholes and boxes for exterior underground cabling.

## 1.3 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid conduit.
- C. IMC: Intermediate metal conduit.
- D. RTRC: Reinforced thermosetting resin conduit.



#### 1.4 ACTION SUBMITTALS

- A. Product data for the following:
  - 1. Surface pathways
  - 2. Wireways and fittings.
  - 3. Tele-power poles.
  - 4. Boxes, enclosures, and cabinets.
  - 5. Underground handholes and boxes.
- B. Sustainable Design Submittals:
  - 1. [<Double click to insert sustainable design text for adhesives and sealants.>](#)
- C. Shop Drawings: For custom enclosures and cabinets[ **and custom underground handholes and boxes**]. Include plans, elevations, sections, and attachment details.
- D. Samples: For [**wireways**] [**nonmetallic wireways**] [**surface pathways**] [**and**] [**tele-power poles**] and for each color and texture specified, [**12 inches (300 mm)**] **<Insert dimension>** long.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
  - 3. Underground ducts, piping, and structures in location of underground enclosures and handholes.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: [**Seismic rating**] [**Provide seismic bracing**] for all pathway racks, enclosures, cabinets, equipment racks, and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- D. Source quality-control reports.

## PART 2 - PRODUCTS

## 2.1 METAL CONDUITS AND FITTINGS

- A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569-D.
- D. GRC: Comply with ANSI C80.1 and UL 6.
- E. ARC: Comply with ANSI C80.5 and UL 6A.
- F. IMC: Comply with ANSI C80.6 and UL 1242.
- G. PVC-Coated Steel Conduit: PVC-coated [**GRC**] [**IMC**].
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: **0.040 inch (1 mm)**, minimum.
- H. EMT: Comply with ANSI C80.3 and UL 797.
- I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: [**Steel**] [**or**] [**die cast**].
    - b. Type: [**Set screw**] [**or**] [**compression**].
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  - 4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of **0.040 inch (1 mm)**, with overlapping sleeves protecting threaded joints.
- J. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS AND FITTINGS

- A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. General Requirements for Nonmetallic Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with TIA-569-D.
- D. RNC: [**Type EPC-40-PVC**] [**Type EPC-80-PVC**] <Insert type>, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- E. Rigid HDPE: Comply with UL 651A.
- F. Continuous HDPE: Comply with UL 651A.
- G. RTRC: Comply with UL 2515A and NEMA TC 14.
- H. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.
- I. Solvents and Adhesives: As recommended by conduit manufacturer.
  - 1. [<Double click to insert sustainable design text for solvents and adhesives.>](#)

## 2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

- A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for [**plenum**] [**riser**] [**or**] [**general-use**] installation unless otherwise indicated.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.

## 2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. General Requirements for Metal Wireways and Auxiliary Gutters:
  - 1. Comply with UL 870 and NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4**] [**Type 12**] <Insert type> unless otherwise indicated, and sized according to NFPA 70.
  - 2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 3. Comply with TIA-569-D.

- D. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: [**Hinged type**] [**Screw-cover type**] [**Flanged-and-gasketed type**] unless otherwise indicated.
- F. Finish: Manufacturer's standard enamel finish.

## 2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

- A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.
- B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.
- C. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:
  - 1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Comply with TIA-569-D.
- E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.
  - 1. [<Double click to insert sustainable design text for solvents and adhesives.>](#)

## 2.6 SURFACE METAL PATHWAYS

- A. Description: Galvanized steel with snap-on covers, complying with UL 5.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Finish: [**Manufacturer's standard enamel finish in color selected by Architect**] [**Prime coated, ready for field painting**].
- D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- E. Comply with TIA-569-D.

## 2.7 SURFACE NONMETALLIC PATHWAYS:

- A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Finish: Texture and color selected by Architect from [**manufacturer's standard**] [**custom**] colors.
- D. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
- E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- F. Comply with TIA-569-D.

## 2.8 TELE-POWER POLES:

- A. Description: Prefabricated, finished metal pole with prewired power and communications outlets.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Material: [**Galvanized steel with ivory baked-enamel finish**] [**Aluminum with clear anodized finish**].
- D. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.
- E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- F. Comply with TIA-569-D.

## 2.9 HOOKS

- A. Description: Prefabricated sheet metal cable supports for telecommunications cable.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
- D. Comply with TIA-569-D.
- E. [**Galvanized**] [**stainless**] steel.
- F. [**J**] [**U**] shape.

## 2.10 BOXES, ENCLOSURES, AND CABINETS

- A. Description: Enclosures for communications.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-D.
  2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
  3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
  4. Device Box Dimensions: [**4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep)**] [**4 inches by 2-1/8 inches by 2-1/8 inches deep (100 mm by 60 mm by 60 mm deep)**] <Insert other dimension>.
  5. Gangable boxes are [**allowed**] [**prohibited**].
- D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, [**ferrous alloy**] [**aluminum**], Type FD, with gasketed cover.
- F. Metal Floor Boxes:
1. Material: [**Cast metal**] [**or**] [**sheet metal**].
  2. Type: [**Fully adjustable**] [**Semi-adjustable**].
  3. Shape: Rectangular.
  4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- G. Nonmetallic Floor Boxes: Nonadjustable, [**round**] [**rectangular**].
1. Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, [**cast aluminum**] [**galvanized, cast iron**] with gasketed cover.
- J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, [**Type 1**] [**Type 3R**] [**Type 4**] [**Type 12**] <Insert type>, with continuous-hinge cover with flush latch unless otherwise indicated.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  2. Nonmetallic Enclosures:
    - a. Material: [**Plastic**] [**Fiberglass**].
    - b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:

1. NEMA 250, [Type 1] [Type 3R] [Type 12] <Insert type> galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.
6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.11 POLYMER-CONCRETE HANDHOLES

- A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. General Requirements for Polymer Concrete Handholes:
  1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  3. Comply with TIA-569-D[ and SCTE 77].
- D. Configuration: Designed for flush burial with [open] [closed] [integral closed] bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
  1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
  2. Cover Legend: Molded lettering, ["COMMUNICATIONS"] <Insert legend>.
- F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- G. Handholes [12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)] <Insert dimensions> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.12 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with frame and covers of [polymer concrete] [reinforced concrete] [cast iron] [hot-dip galvanized-steel diamond plate] [fiberglass].

- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. General Requirements for Fiberglass Handholes and Boxes:
  - 1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
  - 3. Comply with TIA-569-D[ **and SCTE 77**].
- D. Color of Frame and Cover: [**Gray**] [**Green**].
- E. Configuration: Designed for flush burial with [**open**] [**closed**] [**integral closed**] bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, ["**COMMUNICATIONS**"] <Insert legend>.
- I. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
- J. Handholes [**12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long)**] <Insert **dimensions**> and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.13 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

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

## PART 3 - EXECUTION

### 3.1 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: [**GRC**] [**IMC**] [**RNC, Type EPC-40-PVC**] [**RNC, Type EPC-80-PVC**].



2. Concealed Conduit, Aboveground: [GRC] [IMC] [EMT] [RNC, Type EPC-40-PVC].
  3. Underground Conduit: RNC, [Type EPC-40-PVC] [Type EPC-80-PVC], [direct buried] [concrete encased].
  4. Boxes and Enclosures, Aboveground: NEMA 250, [Type 3R] [Type 4].
- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
1. Exposed, Not Subject to Physical Damage: [EMT] [or] [RNC].
  2. Exposed, Not Subject to Severe Physical Damage: [EMT] [RNC identified for such use].
  3. Exposed and Subject to Severe Physical Damage: [GRC] [IMC]. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Gymnasiums
    - e. <Insert designations of applicable spaces or locations>.
  4. Concealed in Ceilings and Interior Walls and Partitions: [EMT] [RNC, Type EPC-40-PVC] [or] [innerduct].
  5. Damp or Wet Locations: [GRC] [IMC].
  6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: [Plenum-type, optical-fiber-cable pathway] [Plenum-type, communications-cable pathway] [EMT] <Insert pathway type>.
  7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: [Riser-type, optical-fiber-cable pathway] [Riser-type, communications-cable pathway] [EMT] <Insert pathway type>.
  8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: [General-use, optical-fiber-cable pathway] [Riser-type, optical-fiber-cable pathway] [Plenum-type, optical-fiber-cable pathway] [General-use, communications-cable pathway] [Riser-type, communications-cable pathway] [Plenum-type, communications-cable pathway] [EMT] <Insert pathway type>.
  9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 [stainless steel] [nonmetallic] units in institutional and commercial kitchens and damp or wet locations.
- C. Minimum Pathway Size: 3/4-inch (21-mm) trade size for copper and aluminum cables, and 1 inch (25 mm) for optical-fiber cables.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  3. EMT: Use [set-screw] [or] [compression], [steel] [cast-metal] fittings. Comply with NEMA FB 2.10.

- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds [120 deg F (49 deg C)] <Insert temperature>.

### 3.2 INSTALLATION

- A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:
  - 1. NECA 1.
  - 2. NECA/BICSI 568.
  - 3. TIA-569-D.
  - 4. NECA 101
  - 5. NECA 102.
  - 6. NECA 105.
  - 7. NECA 111.
- B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- C. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- D. Comply with requirements in Section 270529 "Hangers and Supports for Communications Systems" for hangers and supports.
- E. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.
- F. Keep pathways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- G. Complete pathway installation before starting conductor installation.
- H. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches (300 mm) of changes in direction. Utilize long radius ells for all optical-fiber cables.
- J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches (300 mm) of enclosures to which attached.
- L. Pathways Embedded in Slabs:

1. Run conduit larger than **1-inch (27-mm)** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum **10-foot (3-m)** intervals.
  2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
  3. Arrange pathways to keep a minimum of [**1 inch (25 mm)**] [**2 inches (50 mm)**] <Insert dimension> of concrete cover in all directions.
  4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  5. Change from nonmetallic conduit and fittings to [**RNC, Type EPC-40-PVC,**] [**GRC**] [**or**] [**IMC**] and fittings before rising above floor.
- M. Stub-ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for pathways.
  2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- Q. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus one additional quarter-turn.
- R. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure, to assure a continuous ground path.
- S. Cut conduit perpendicular to the length. For conduits of **2-inch (50-mm)** trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- T. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.
- U. Surface Pathways:
1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
  2. Install surface pathway with a minimum **2-inch (50-mm)** radius control at bend points.
  3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding **48 inches (1200 mm)** and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- V. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
1. **3/4-Inch (21-mm)** Trade Size and Smaller: Install pathways in maximum lengths of **50 feet (15 m)**.
  2. **1-Inch (25-mm)** Trade Size and Larger: Install pathways in maximum lengths of **75 feet (23 m)**.
  3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- W. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway-sealing fittings according to NFPA 70.
- X. Install devices to seal pathway interiors at accessible locations. Locate seals, so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  2. Where an underground service pathway enters a building or structure.
  3. Where otherwise required by NFPA 70.
- Y. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- Z. Expansion-Joint Fittings:
1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed **30 deg F (17 deg C)**, and that has straight-run length that exceeds **25 feet (7.6 m)**. Install in each run of aboveground RMC[ **and EMT**] that is located where environmental temperature change may exceed **100 deg F (55 deg C)**, and that has straight-run length that exceeds **100 feet (30 m)**.
  2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: [**125 deg F (70 deg C)**] **<Insert temperature>** temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: [**155 deg F (86 deg C)**] **<Insert temperature>** temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: [**125 deg F (70 deg C)**] **<Insert temperature>** temperature change.
    - d. Attics: [**135 deg F (75 deg C)**] **<Insert temperature>** temperature change.
    - e. **<Insert location and corresponding temperature change>**.
  3. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C)** of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least **0.000078 inch per foot of length of straight run per deg F (0.0115**

mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches (150 mm) of slack. The lowest point of the cables shall be no less than 6 inches (150 mm) adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet (1.5 m) o.c.
5. Provide a hook at each change in direction.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to [center] [top] [bottom] of box unless otherwise indicated.

CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

EE. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

FF. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

GG. Set metal floor boxes level and flush with finished floor surface.

HH. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe of less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches (300 mm)** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete around conduit for a minimum of **12 inches (300 mm)** on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of **60 inches (1500 mm)** from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately **12 inches (300 mm)** above direct-buried conduits, but a minimum of **6 inches (150 mm)** below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 270553 "Identification for Communications Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch (12.5-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures **1 inch (25 mm)** above finished grade.
- D. Install handholes with bottom below frost line, **<Insert depth of frost line below grade at Project site>** below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 270528

**SECTION 270543 - UNDERGROUND PATHWAYS AND STRUCTURES FOR COMMUNICATION SYSTEMS****TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

**PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY****A. Section Includes:**

1. Metal conduit and fittings, including GRC and PVC-coated GRC.
2. Rigid nonmetallic duct.
3. Duct accessories, including rigid innerduct and fabric innerduct.
4. Precast concrete handholes.
5. Polymer concrete handholes and boxes with polymer concrete cover.
6. Fiberglass handholes and boxes with polymer concrete cover.
7. Fiberglass handholes and boxes.
8. High density plastic boxes.
9. Precast manholes.
10. Cast-in-place manholes.
11. Utility structure accessories.

**1.3 DEFINITIONS**

- A. Direct-Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials, such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
  1. Two or more ducts installed in parallel, with or without additional casing materials.
  2. Multiple duct banks.



- D. GRC: Galvanized rigid conduit.
- E. IMC: Intermediate metal conduit.
- F. RNC: Rigid nonmetallic conduit.
- G. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include duct-bank materials, including spacers and miscellaneous components.
  - 2. Include duct and conduits and their accessories, including elbows, end bells, bends, fittings, duct spacers and solvent cement.
  - 3. Include accessories for manholes, handholes, **[and] boxes[, and other utility structures]**.
  - 4. Include underground-line warning tape.
- B. Shop Drawings:
  - 1. Precast or Factory-Fabricated Underground Utility Structures:
    - a. Include plans, elevations, sections, details, attachments to other work, and accessories.
    - b. Include duct entry provisions, including location and duct size.
    - c. Include reinforcement details.
    - d. Include frame and cover design and manhole chimneys.
    - e. Include **[ladder] [step]** details.
    - f. Include grounding details.
    - g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
    - h. Include joint details.
  - 2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:
    - a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
    - b. Include duct entry provisions, including location and duct size.
    - c. Include cover design.
    - d. Include grounding details.
    - e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
- C. Sustainable Design Submittals:
  - 1. [<Double click to insert sustainable design text for adhesives and sealants.>](#)

### 1.5 INFORMATIONAL SUBMITTALS

- A. Duct and Duct-Bank Coordination Drawings: Show duct profiles and coordination with other utilities and underground structures.
  - 1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
  - 2. Drawings shall be signed and sealed by a qualified professional engineer.
- B. Product Certificates: For concrete and steel used in precast concrete [**manholes**] [**and**] [**handholes**], as required by ASTM C 858.
- C. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.
- D. Source quality-control reports.
- E. Field quality-control reports.

### 1.6 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, <Insert accessories and specialties> and associated fasteners in quantities equal to [**5**] <Insert number> percent of quantity of each item installed.

### 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

### 1.8 FIELD CONDITIONS

- A. Interruption of Existing Communications Service: Do not interrupt communications service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary communications service according to requirements indicated:
  - 1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <Insert number> days in advance of proposed interruption of communications service.
  - 2. Do not proceed with interruption of communications service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.
- B. Ground Water: Assume ground-water level is at grade level unless a lower water table is noted on Drawings.
- C. Ground Water: Assume ground-water level is [**36 inches (900 mm)**] <Insert dimension> below ground surface unless a higher water table is noted on Drawings.

## PART 2 - PRODUCTS

## 2.1 METAL CONDUITS AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. PVC-Coated Steel Conduit: PVC-coated [**GRC**] [**IMC**].
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: **0.040 inch (1 mm)**, minimum.
- C. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569-C and TIA-758-C.

## 2.2 RIGID NONMETALLIC DUCTS

- A. Underground Plastic Utilities Duct: [**Type EPC-80-PVC**] [**and**] [**Type EPC-40-PVC**] RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Underground Plastic Utilities Duct: [**Type DB-60-PVC**] [**and**] [**Type DB-120-PVC**] RNC, complying with NEMA TC 6 & 8 and with ASTM F-512 for direct burial, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- C. Underground Plastic Utilities Duct: Type EB-20 PVC RNC, complying with NEMA TC 6 & 8, ASTM F-512, and UL 651, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- D. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- E. General Requirements for Nonmetallic Ducts and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
  - 2. Comply with TIA-569-C and TIA-758-C.
- F. Solvents and Adhesives: As recommended by duct manufacturer.
  - 1. [<Double click to insert sustainable design text for VOC limits for exterior ducts.>](#)

## 2.3 FLEXIBLE NONMETALLIC DUCTS

- A. HDPE Duct: [**Type EPEC 40-HDPE**] [**Type EPEC 80-HDPE**] complying with NEMA TC 7 and UL 651A.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
3. Comply with TIA-569-C and TIA-758-C.

## 2.4 DUCT ACCESSORIES

- A. Rigid Innerduct: [**Smooth**] [**Corrugated**] HDPE duct, orange in color, designed for installation within a duct or pathway.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Fabric Innerduct: Continuous, polyester, [**single**] [**multi**] -pocket fabric innerduct, with internal pull tape and tracer wire.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Duct Spacers: Factory-fabricated rigid PVC interlocking spacers, sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Underground-Line Warning Tape: Underground-line warning tape specified in Section 270553 "Identification for Communications Systems."

## 2.5 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Monolithically poured, factory-fabricated, reinforced-concrete walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Comply with ASTM C 858 for design and manufacturing processes.
- D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- E. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- F. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
  1. Cover Hinges: Concealed, with hold-open ratchet assembly.
  2. Cover Handle: Recessed.

- G. Frame and Cover: Weatherproof aluminum frame, with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
1. Cover Hinges: Concealed, with hold-open ratchet assembly.
  2. Cover Handle: Recessed.
- H. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- I. Cover Legend: Molded lettering, "[COMMUNICATIONS] [COMM] <Insert legend>."
- J. Configuration: Units shall be designed for flush burial and have [open] [closed] [integral closed] bottom unless otherwise indicated.
- K. Extensions and Slabs: Designed to mate with bottom of enclosure, and made of same material as enclosure.
1. Extension shall provide increased depth of [12 inches (300 mm)] <Insert dimension>.
  2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
- L. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- M. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct and duct banks, plus an additional [6 inches (150 mm)] [12 inches (300 mm)] vertically and horizontally to accommodate alignment variations.
1. Knockout panels shall be located no less than 6 inches (150 mm) from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
  2. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
  3. Knockout panel openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  4. Knockout panels shall be 1-1/2 to 2 inches (38 to 50 mm) thick.
- N. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
1. Type and size shall match fittings to duct or conduit to be terminated.
  2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
- O. Handholes [12 inches wide by 24 inches long (300 mm wide by 600 mm long)] <Insert dimensions> and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.6 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER

- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: **[Gray]** **[Green]**.
- E. Configuration: Units shall be designed for flush burial and have **[open]** **[closed]** **[integral closed]** bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "[COMMUNICATIONS] ["COMM] **<Insert legend>**."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes **[12 inches wide by 24 inches long (300 mm wide by 600 mm long)]** **<Insert dimensions>** and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.7 FIBERGLASS HANDHOLES AND BOXES WITH POLYMER CONCRETE FRAME AND COVER

- A. Description: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: **[Gray]** **[Green]**.
- E. Configuration: Units shall be designed for flush burial and have **[open]** **[closed]** **[integral closed]** bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.

- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "[COMMUNICATIONS] ["COMM] <Insert legend>."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes [**12 inches wide by 24 inches long (300 mm wide by 600 mm long)**] <Insert dimensions> and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.8 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with covers made of [**polymer concrete**] [**reinforced concrete**] [**cast iron**] [**hot-dip galvanized-steel diamond plate**] [**fiberglass**].
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: [**Gray**] [**Green**].
- E. Configuration: Units shall be designed for flush burial and have [**open**] [**closed**] [**integral closed**] bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "[COMMUNICATIONS] ["COMM] <Insert legend>."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes [**12 inches wide by 24 inches long (300 mm wide by 600 mm long)**] <Insert dimensions> and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.9 HIGH-DENSITY PLASTIC BOXES

- A. Description: Injection molded of high-density polyethylene or copolymer-polypropylene. Cover shall be made of **[polymer concrete]** **[hot-dip galvanized-steel diamond plate]** **[plastic]**.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: **[Gray]** **[Green]**.
- E. Configuration: Units shall be designed for flush burial and have **[open]** **[closed]** **[integral closed]** bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "**[COMMUNICATIONS]** **[\"COMM]** **<Insert legend>**."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes **[12 inches wide by 24 inches long (300 mm wide by 600 mm long)]** **<Insert dimensions>** and larger shall have factory-installed inserts for cable racks and pulling-in irons.

## 2.10 PRECAST MANHOLES

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Standard: Comply with ASTM C 858.
- D. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- E. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct and duct banks, plus an additional **[6 inches (150 mm)]** **[12 inches (300 mm)]** vertically and horizontally to accommodate alignment variations.
  - 1. **[Splayed]** **[Center window]** location.



2. Knockout panels shall be located no less than **6 inches (150 mm)** from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
  3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct banks.
  4. Knockout panel openings shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
  5. Knockout panels shall be **1-1/2 to 2 inches (38 to 50 mm)** thick.
- F. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
1. Type and size shall match fittings to duct or conduit to be terminated.
  2. Fittings shall align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
- G. Ground Rod Sleeve: Provide a **3-inch (75-mm)** PVC sleeve in manhole floors **2 inches (50 mm)** from the wall adjacent to, but not underneath, the duct routed from the facility.
- H. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

## 2.11 CAST-IN-PLACE MANHOLES

- A. Description: Underground utility structures, constructed in place, complete with accessories, hardware, and features. Include concrete knockout panels for duct entrance and sleeve for ground rod.
- B. Materials: Comply with ASTM C 858 and with Section 033000 "Cast-in-Place Concrete."
- C. Structural Design Loading: As specified in "Underground Enclosure Application" Article.

## 2.12 UTILITY STRUCTURE ACCESSORIES

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, [**gray cast iron complying with ASTM A 48/A 48M, Class 30B**] [**cast aluminum**], with milled cover-to-frame bearing surfaces; [**26-inch (660-mm)**] [**29-inch (725-mm)**] diameter.
    - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
    - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.

2. Cover Legend: Cast in. Selected to suit system.
3. Manhole Chimney Components: Precast concrete rings, with dimensions matched to those of roof opening.
  - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C 270, Type M, except for quantities of less than **2.0 cu. ft. (60 L)**, where packaged mix complying with ASTM C 387, Type M, may be used.
  - b. Seal joints watertight using preformed plastic or rubber conforming to ASTM C 990. Install sealing material according to the sealant manufacturers' printed instructions.
- D. Manhole Sump Frame and Grate: ASTM A 48/A 48M, Class 30B, gray cast iron.
- E. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, **2-inch- (50-mm-)** diameter eye, and **1-by-4-inch (25-by-100-mm)** bolt.
  1. Working Load Embedded in **6-Inch (150-mm)**, **4000-psi (27.6-MPa)** Concrete: **13,000-lbf (58-kN)** minimum tension.
- F. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, **1-1/4-inch- (31-mm-)** diameter eye, rated [**2500-lbf (11-kN)**] **<Insert value>** minimum tension.
- G. Pulling-In and Lifting Irons in Concrete Floors: **7/8-inch- (22-mm-)** diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
  1. Ultimate Yield Strength: **40,000-lbf (180-kN)** shear and **60,000-lbf (270-kN)** tension.
- H. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; **1/2-inch (13-mm)** ID by **2-3/4 inches (69 mm)** deep, flared to a minimum of **1-1/4 inches (31 mm)** at base.
  1. Tested Ultimate Pullout Strength: **12,000 lbf (53 kN)** minimum.
- I. Ground Rod Sleeve: **3-inch (75-mm)**, PVC duct sleeve in manhole floors **2 inches (50 mm)** from the wall adjacent to, but not underneath, the duct entering the structure.
- J. Expansion Anchors for Installation after Concrete Is Cast: Zinc-plated, carbon-steel-wedge type with stainless-steel expander clip, with **1/2-inch (13-mm)** bolt, **5300-lbf (24-kN)** rated pullout strength, and minimum **6800-lbf (30-kN)** rated shear strength.
- K. Cable Rack Assembly: Nonmetallic. Components fabricated from nonconductive, fiberglass-reinforced polymer.
  1. Stanchions: Nominal **36 inches (900 mm)** high by **4 inches (100 mm)** wide, with minimum of nine holes for arm attachment.
  2. Arms: Arranged for secure, drop-in attachment in horizontal position at any location on cable stanchions, and capable of being locked in position. Arms shall be available in lengths ranging from **3 inches (75 mm)** with **450-lb (204-kg)** minimum capacity to **20**

**inches (500 mm)** with **250-lb (114-kg)** minimum capacity. Top of arm shall be nominally **4 inches (100 mm)** wide, and arm shall have slots along full length for cable ties.

- L. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as **35 deg F (2 deg C)**. Capable of withstanding temperature of **300 deg F (150 deg C)** without slump and adhering to clean surfaces of plastic duct, metallic duct, duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- M. Fixed Manhole Ladders: Arranged for attachment to **[roof] [or] [wall] [ and floor]** of manhole. Ladder, mounting brackets, and braces shall be fabricated from **[nonconductive, structural-grade, fiberglass-reinforced resin] [hot-dip galvanized steel]**.
- N. Portable Manhole Ladders: UL-listed, heavy-duty **[wood] [fiberglass]** specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus **36 inches (900 mm)**. **[One]** **<Insert number>** required.
- O. Cover Hooks: **[Heavy duty, designed for lifts 60 lbf (270 N) and greater] [Light duty, designed for lifts less than 60 lbf (270 N)]**. **[Two]** **<Insert number>** required.

## 2.13 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C 1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
  - 1. Tests of materials shall be performed by an independent testing agency.
  - 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
  - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by Architect.

- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

### 3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Communications: [**Type EPC-80-PVC**] [**Type EPC-40-PVC**] [**Type EB-20-PVC**] RNC, in concrete-encased duct bank unless otherwise indicated.
- B. Duct for Communications: [**Type EPC-80-PVC**] [**Type EPC-40-PVC**] [**Type DB-60-PVC**] [**Type DB-120-PVC**] RNC, in direct-buried duct bank unless otherwise indicated.
- C. Duct for Communications: [**Type EPEC-40-HDPE**] [**Type EPEC-80-HDPE**] duct in direct-bored duct bank unless otherwise indicated.
- D. Underground Duct Crossing [**Paved Paths**] [**Walks**] [**and**] [**Driveways**] [**Roadways**] [**and Railroads**]: Type EPC-40-PVC RNC, encased in reinforced concrete.
- E. Stub-Ups for Communications: Concrete-encased [**RNC**] [**GRC**] [**PVC-coated GRC**].

### 3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for Communications:
  1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, [**H-10**] [**H-20**] structural load rating.
  2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: [**Precast concrete, AASHTO HB 17, H-20**] [**Polymer concrete, SCTE 77, Tier 15**] [**Fiberglass enclosures with polymer concrete frame and cover, SCTE 77, Tier 15**] [**Fiberglass-reinforced polyester resin, SCTE 77, Tier 15**] [**High-density plastic, SCTE 77, Tier 15**] structural load rating.
  3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: [**Precast concrete, AASHTO HB 17, H-5**] [**Precast concrete, AASHTO HB 17, H-10**] [**Polymer concrete units, SCTE 77, Tier 8**] [**Heavy-duty fiberglass units with polymer concrete frame and cover, SCTE 77, Tier 8**] [**High-density plastic, SCTE 77, Tier 8**] structural load rating.
  4. Units Subject to Light-Duty Pedestrian Traffic Only: [**Fiberglass-reinforced polyester resin**] [**High-density plastic**], structurally tested according to SCTE 77 with **3000-lbf (13 345-N)** vertical loading.
  5. Cover design load shall not exceed the design load of the handhole or box.
- B. Manholes: [**Precast**] [**or**] [**cast-in-place**] concrete.
  1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
  2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

### 3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area [**immediately after backfilling is completed**] [**or**] [**after construction in immediate area is complete**].
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf and Grasses" and Section 329300 "Plants."
- E. Cut and patch existing pavement in the path of underground duct, duct bank, and utility structures according to the "Cutting and Patching" Article in Section 017300 "Execution."

### 3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct and duct bank according to NEMA TCB 2 and TIA-758-C.
- C. Slope: Pitch duct and duct bank a minimum slope of 1:100 down toward manholes and handholes and away from buildings and equipment. Slope duct and duct bank from a high point in runs between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of [**48 inches (1200 mm)**] [**12.5 feet (4 m)**] [**25 feet (7.5 m)**], both horizontally and vertically, at other locations unless otherwise indicated.
  - 1. Duct and duct banks shall have maximum of two 90-degree bends, or the total of all bends shall be no more 180 degrees between pull points.
- E. Joints: Use solvent-cemented joints in duct and fittings, and make watertight according to manufacturer's written instructions. Stagger couplings, so those of adjacent ducts do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct or duct banks are installed parallel to underground steam lines, perform calculations showing the duct or duct bank will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct or duct bank crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.

- G. End-Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately **6 inches (150 mm)** o.c. for **4-inch (100-mm)** duct, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to end-bell spacing **10 feet (3 m)** from the end bell without reducing duct slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight-line direct-buried duct and duct banks, with calculated expansion of more than **3/4 inch (19 mm)**.
  3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately **6 inches (150 mm)** o.c. for **4-inch (100-mm)** duct, and vary proportionately for other duct sizes.
1. Begin change from regular spacing to terminator spacing **10 feet (3 m)** from the terminator without reducing duct slope and without forming a trap in the line.
  2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight-line duct or duct bank, with calculated expansion of more than **3/4 inch (19 mm)**.
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least **10 feet (3 m)** outside the building wall, without reducing duct slope away from the building or forming a trap in the duct. Use fittings manufactured for RNC duct-to-GRC conduit transition. Install GRC penetrations of building walls as specified in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct that has cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least **15-psig (1.03-MPa)** hydrostatic pressure.
- K. Innerduct: Install immediately after mandreling duct. [**Size and type as indicated on Drawings.**] [**Provide three innerducts per duct.**]
- L. Pulling Cord: Install **200-lbf- (1000-N-m)** test nylon cord in empty duct [**and innerduct**].
- M. Concrete-Encased Duct and Duct Bank:
1. Excavate trench bottom to provide firm and uniform support for duct or duct bank. Prepare trench bottoms as specified in Section 312000 "Earth Moving" for pipes less than **6 inches (150 mm)** in nominal diameter.
  2. Width: Excavate trench **12 inches (300 mm)** wider than duct or duct bank on each side.
  3. Width: Excavate trench **3 inches (75 mm)** wider than duct or duct bank on each side.
  4. Depth: Install top of duct and duct bank at least **24 inches (600 mm)** below finished grade in areas not subject to deliberate traffic, and at least **30 inches (750 mm)** below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
  5. Support duct and duct bank on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.

6. Minimum Space Between Duct: **3 inches (75 mm)** between edge of duct and exterior envelope wall, **2 inches (50 mm)** between ducts for like services, and **4 inches (100 mm)** between power and communications ducts.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than **[four] [five]** spacers per **20 feet (6 m)** of duct. Place spacers within **24 inches (600 mm)** of duct ends. Stagger spacers approximately **6 inches (150 mm)** between tiers. Secure spacers to earth and duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around duct or duct bank.
8. Elbows: Use manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct run unless otherwise indicated. Extend concrete encasement throughout length of elbow.
9. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
  - a. Couple GRC to duct with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete.
  - b. Stub-Ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of **60 inches (1500 mm)** from edge of base. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be **[flush with] [minimum 4 inches (100 mm)above]** finished floor and minimum **3 inches (75 mm)** from conduit side to edge of slab.
  - c. Stub-Ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of **60 inches (1500 mm)** from edge of wall. Install insulated grounding bushings on terminations at equipment.
    - 1) Stub-ups shall be **[flush with] [minimum 4 inches (100 mm)above]** finished floor and no less than **3 inches (75 mm)** from conduit side to edge of wall.
10. Reinforcement: Reinforce concrete-encased duct and duct bank where they cross disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
11. Forms: Use trench walls to form side walls of duct and duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
12. Concrete Cover: Install a minimum of **3 inches (75 mm)** of concrete cover between edge of duct to exterior envelope wall, **2 inches (50 mm)** between ducts, and **4 inches (100 mm)** between power and communications duct.
13. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
  - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written recommendations, or use other specific measures to prevent expansion-contraction damage.

- b. If more than one pour is necessary, terminate each pour in a vertical plane and install **3/4-inch (19-mm)** reinforcing-rod dowels extending a minimum of **18 inches (450 mm)** into concrete on both sides of joint near corners of envelope.
  14. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between ducts and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto duct. Allow concrete to flow to center of bank and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-bank application.
- N. Direct-Buried Duct and Duct Banks:
1. Excavate trench bottom to provide firm and uniform support for duct and duct bank. Comply with requirements in Section 312000 "Earth Moving" for preparation of trench bottoms for duct less than **6 inches (150 mm)** in nominal diameter.
  2. Install duct with a minimum of **3 inches (75 mm)** between duct for like services and **6 inches (150 mm)** between power and signal duct.
  3. Width: Excavate trench **12 inches (300 mm)** wider than duct or duct bank on each side.
  4. Width: Excavate trench **3 inches (75 mm)** wider than duct or duct bank on each side.
  5. Depth: Install top of duct or duct bank at least **36 inches (900 mm)** below finished grade unless otherwise indicated.
  6. Set elevation of bottom of duct or duct bank below frost line.
  7. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
  8. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than **[four] [five]** spacers per **20 feet (6 m)** of duct. Place spacers within **24 inches (600 mm)** of duct ends. Stagger spacers approximately **6 inches (150 mm)** between tiers. Secure spacers to earth and duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around duct or duct bank.
  9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances through floor, and at changes of direction in duct unless otherwise indicated. Encase elbows for stub-ups throughout length of elbow. **[Extend encasement minimum of 36 inches (900 mm) beyond elbow joints].**
  10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
    - a. Couple GRC to duct with adapters designed for this purpose, and encase coupling with **3 inches (75 mm)** of concrete.
    - b. For equipment mounted on outdoor bases, extend GRC horizontally a minimum of **60 inches (1500 mm)** from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.
  11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving duct at end of run free to move with expansion and contraction, as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to **4 inches (100 mm)** over duct and hand tamp. Firmly tamp backfill around duct to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply



with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

- a. Place minimum of **3 inches (75 mm)** of sand as a bed for duct and duct bank. Place sand to a minimum of **6 inches (150 mm)** above top level of duct and duct bank.
  - b. Place minimum of **6 inches (150 mm)** of engineered fill above concrete encasement of duct bank.
- O. Underground-Line Warning Tape: Bury [**nonconducting**] [**conducting**] underground-line warning tape specified in Section 270553 "Identification for Communication Systems" no less than **12 inches (300 mm)** above all concrete-encased duct and duct bank [**and approximately 12 inches (300 mm) below grade**]. Align tape parallel to and within **3 inches (75 mm)** of centerline of duct bank. Provide an additional warning tape for each **12-inch (300-mm)** increment of duct-bank width over a nominal **18 inches (450 mm)**. Space additional tapes **12 inches (300 mm)** apart, horizontally.

### 3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

#### A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Knockouts for Future Duct Connections: Form and pour concrete knockout panels **1-1/2 to 2 inches (38 to 50 mm)** thick, arranged as indicated.
3. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.

#### B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C 891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1-inch (25-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.

#### C. Elevations:

1. Manhole Roof: Install with rooftop at least **15 inches (380 mm)** below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames **1 inch (25 mm)** above finished grade.
3. Install handholes with bottom below frost line, **<Insert depth of frost line below grade at Project site>** below grade.
4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes **1 inch (25 mm)** above finished grade.
5. Where indicated, cast handhole cover frame integrally with handhole structure.

#### D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.

#### E. Manhole Access: Circular opening in manhole roof; sized to match cover size.

1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
  2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.
- F. Waterproofing: Apply waterproofing to exterior surfaces of manholes[ **and handholes**] after concrete has cured at least three days. Waterproofing materials and installation are specified in [Section 071353 "Elastomeric Sheet Waterproofing."] [Section 071354 "Thermoplastic Sheet Waterproofing."] <Insert waterproofing Section>. After duct has been connected and grouted, and before backfilling, waterproof joints and connections, and touch up abrasions and scars. Waterproof exterior of manhole chimneys after mortar has cured at least three days.
- G. Dampproofing: Apply dampproofing to exterior surfaces of manholes[ **and handholes**] after concrete has cured at least three days. Dampproofing materials and installation are specified in Section 071113 "Bituminous Dampproofing." After duct has been connected and grouted, and before backfilling, dampproof joints and connections, and touch up abrasions and scars. Dampproof exterior of manhole chimneys after mortar has cured at least three days.
- H. Hardware: Install removable hardware, including pulling eyes, cable stanchions, [**and** ]cable arms, [**and insulators**], as required for installation and support of cables and conductors and as indicated.
- I. Fixed Manhole Ladders: Arrange to provide for safe entry with maximum clearance from cables and other items in manholes.
- J. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than **3-7/8 inches (97 mm)** for manholes and **2 inches (50 mm)** for handholes, for field-installed anchor bolts installed. Use a minimum of two anchors for each cable stanchion.
- 3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE
- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct and duct bank, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from **1/2-inch (12.5-mm)** sieve to **No. 4 (4.75-mm)** sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes **1 inch (25 mm)** above finished grade.
- D. Install handholes and boxes with bottom below frost line, <Insert depth of frost line below grade at Project site> below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm

lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.

- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.
- G. For enclosures installed in [asphalt paving] [and] <Insert material> and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring, encircling, and in contact with, enclosure, and with top surface screeded to top of box cover frame. Bottom of ring shall rest on [compacted earth] <Insert material>.
  - 1. Concrete: 3000 psi (20 kPa), 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
  - 2. Dimensions: [10 inches wide by 12 inches deep (250 mm wide by 300 mm deep)] <Insert dimensions>.

### 3.8 GROUNDING

- A. Ground underground duct, duct bank, and utility structures according to Section 270526 "Grounding and Bonding for Communications Systems."

### 3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
  - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
  - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch- (300-mm-) long mandrel equal to duct size minus 1/4 inch (6 mm). If obstructions are indicated, remove obstructions and retest.
  - 3. Test manhole[ and handhole] grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Section 270526 "Grounding and Bonding for Communications Systems."
- B. Correct deficiencies and retest as specified above to demonstrate compliance.

### 3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris.
- B. Clean internal surfaces of manholes, including sump.
  - 1. Sweep floor, removing dirt and debris.
  - 2. Remove foreign material.

END OF SECTION 270543

## SECTION 311000 - SITE CLEARING

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Stripping and stockpiling rock.
6. Removing above- and below-grade site improvements.
7. Disconnecting, capping or sealing, and **[removing site utilities] [abandoning site utilities in place]**.
8. Temporary erosion and sedimentation control.

## B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

## C. Related Requirements:

1. Section 01500 "Temporary Facilities and Controls" for temporary erosion- and sedimentation-control measures.

## 1.3 DEFINITIONS

- A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

- B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.
- C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow.
- D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than **2 inches (50 mm)** in diameter; and free of weeds, roots, toxic materials, or other nonsoil materials.
- E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.
- F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and **[indicated on Drawings] [indicated according to requirements in Section 015639 "Temporary Tree and Plant Protection. "] <Insert requirement>**.
- G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] <Insert location>**.

#### 1.5 MATERIAL OWNERSHIP

- A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
  - 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 plant designated to remain.
- B. Topsoil stripping and stockpiling program.
- C. Rock stockpiling program.
- D. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

- E. Burning: Documentation of compliance with burning requirements and permitting of authorities having jurisdiction. Identify location(s) and conditions under which burning will be performed.

#### 1.7 QUALITY ASSURANCE

- A. Topsoil Stripping and Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.
- B. Rock Stockpiling Program: Prepare a written program to systematically demonstrate the ability of personnel to properly follow procedures and handle materials and equipment during the Work. Include dimensioned diagrams for placement and protection of stockpiles.

#### 1.8 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  - 2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
  - 1. Do not proceed with work on adjoining property until directed by Architect.
- C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises[ **where indicated**] <Insert location>.
- D. Utility Locator Service: Notify [**utility locator service**] [**Miss Utility**] [**Call Before You Dig**] [**Dig Safe System**] [**One Call**] <Insert name> for area where Project is located before site clearing.
- E. Do not commence site clearing operations until temporary erosion- and sedimentation-control[ **and plant-protection**] measures are in place.
- F. Tree- and Plant-Protection Zones: Protect according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Section 312000 "Earth Moving."
  - 1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.
- B. Antirust Coating: Fast-curing, lead- and chromate-free, self-curing, universal modified-alkyd primer complying with [**MPI #23 (surface-tolerant, anticorrosive metal primer)**] [**or**] [**SSPC-Paint 20 or SSPC-Paint 29 zinc-rich coating**] <Insert requirement>.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect and maintain benchmarks and survey control points from disturbance during construction.
- B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- C. Protect existing site improvements to remain from damage during construction.
  - 1. Restore damaged improvements to their original condition, as acceptable to Owner.

### 3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.
- B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
- D. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.



### 3.3 TREE AND PLANT PROTECTION

- A. Protect trees and plants remaining on-site according to requirements in Section 015639 "Temporary Tree and Plant Protection."
- B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.4 EXISTING UTILITIES

- A. Owner will arrange for disconnecting and sealing indicated utilities that serve existing structures before site clearing, when requested by Contractor.
  - 1. Verify that utilities have been disconnected and capped before proceeding with site clearing.
- B. Locate, identify, disconnect, and seal or cap utilities indicated to be removed[ **or abandoned in place**].
  - 1. Arrange with utility companies to shut off indicated utilities.
  - 2. Owner will arrange to shut off indicated utilities when requested by Contractor.
- C. Locate, identify, and disconnect utilities indicated to be abandoned in place.
- D. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
  - 1. Notify Architect not less than **[two]** **<Insert number>** days in advance of proposed utility interruptions.
  - 2. Do not proceed with utility interruptions without Architect's written permission.
- E. Excavate for and remove underground utilities indicated to be removed.
- F. Removal of underground utilities is included in earthwork sections; in applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security, and utilities sections; and in Section 024116 "Structure Demolition" and Section 024119 "Selective Demolition."

### 3.5 CLEARING AND GRUBBING

- A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
  - 1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
  - 2. Grind down stumps and remove roots larger than **[2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension>** in diameter, obstructions, and debris to a depth of **[18 inches (450 mm)] <Insert dimension>** below exposed subgrade.
  - 3. Use only hand methods or air spade for grubbing within protection zones.

4. Chip removed tree branches and **[stockpile in areas approved by Architect] [dispose of off-site] <Insert requirement>**.
- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
  1. Place fill material in horizontal layers not exceeding a loose depth of **8 inches (200 mm)**, and compact each layer to a density equal to adjacent original ground.

### 3.6 TOPSOIL STRIPPING

- A. Remove sod and grass before stripping topsoil.
- B. Strip topsoil to depth **[indicated on Drawings] [of 6 inches (150 mm)] <Insert requirement>** in a manner to prevent intermingling with underlying subsoil or other waste materials.
  1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects larger than **2 inches (50 mm)** in diameter; trash, debris, weeds, roots, and other waste materials.
- C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
  1. Limit height of topsoil stockpiles to **[72 inches (1800 mm)] <Insert dimension>**.
  2. Do not stockpile topsoil within protection zones.
  3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
  4. Stockpile surplus topsoil to allow for respreading deeper topsoil.

### 3.7 STOCKPILING ROCK

- A. Remove from **[area indicated on Drawings] [construction area] <Insert requirement>** naturally formed rocks that measure more than **[1 foot (300 mm)] <Insert dimension>** across in least dimension. Do not include excavated or crushed rock.
  1. Separate or wash off non-rock materials from rocks, including soil, clay lumps, gravel, and other objects larger than **2 inches (50 mm)** in diameter; trash, debris, weeds, roots, and other waste materials.
- B. Stockpile rock **[where indicated on Drawings] [away from edge of excavations] <Insert requirement>** without intermixing with other materials. Cover to prevent windblown debris from accumulating among rocks.
  1. Limit height of rock stockpiles to **[36 inches (900 mm)] <Insert dimension>**.
  2. Do not stockpile rock within protection zones.
  3. Dispose of surplus rock. Surplus rock is that which exceeds quantity indicated to be stockpiled or reused.
  4. Stockpile surplus rock to allow later use by the Owner.

### 3.8 SITE IMPROVEMENTS

- A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.
- B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
  - 1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.
  - 2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

### 3.9 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.
- B. Burning tree, shrub, and other vegetation waste is permitted according to burning requirements and permitting of authorities having jurisdiction. Control such burning to produce the least smoke or air pollutants and minimum annoyance to surrounding properties. Burning of other waste and debris is prohibited.
- C. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials, and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

## SECTION 312000 - EARTH MOVING

**TIPS:**

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To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for **[slabs-on-grade] [walks] [pavements] [turf and grasses] [and] [plants]**.
3. Excavating and backfilling for buildings and structures.
4. Drainage course for concrete slabs-on-grade.
5. Subbase course for concrete **[walks] [pavements]**.
6. Subbase course **[ and base course]** for asphalt paving.
7. Subsurface drainage backfill for walls and trenches.
8. Excavating and backfilling trenches for utilities and pits for buried utility structures.
9. Excavating well hole to accommodate elevator-cylinder assembly.

## B. Related Requirements:

1. **[Section 013200 "Construction Progress Documentation"] [Section 013233 "Photographic Documentation"]** for recording preexcavation and earth-moving progress.
2. Section 033000 "Cast-in-Place Concrete" for granular course if placed over vapor retarder and beneath the slab-on-grade.
3. Section 311000 "Site Clearing" for site stripping, grubbing, stripping **[ and stockpiling]** topsoil, and removal of above- and below-grade improvements and utilities.
4. Section 312319 "Dewatering" for lowering and disposing of ground water during construction.
5. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
6. Section 316329 "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.

7. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
8. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

### 1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices for earth moving specified in Section 012200 "Unit Prices."
- B. Quantity allowances for earth moving are included in Section 012100 "Allowances."
- C. Rock Measurement: Volume of rock actually removed, measured in original position, but not to exceed the following. Unit prices for rock excavation include replacement with approved materials.
  1. [24 inches (600 mm)] <Insert dimension> outside of concrete forms other than at footings.
  2. [12 inches (300 mm)] <Insert dimension> outside of concrete forms at footings.
  3. [6 inches (150 mm)] <Insert dimension> outside of minimum required dimensions of concrete cast against grade.
  4. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
  5. [6 inches (150 mm)] <Insert dimension> beneath bottom of concrete slabs-on-grade.
  6. [6 inches (150 mm)] <Insert dimension> beneath pipe in trenches, and the greater of [24 inches (600 mm)] <Insert dimension> wider than pipe or [42 inches (1065 mm)] <Insert dimension> wide.

### 1.4 DEFINITIONS

- A. Backfill: Soil material or controlled low-strength material used to fill an excavation.
  1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
  2. Final Backfill: Backfill placed over initial backfill to fill a trench.
- B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.
- C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.
- D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.
- E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.
- F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for **[unit prices] [changes in the Work]**.
  2. Bulk Excavation: Excavation more than **[10 feet (3 m)] <Insert dimension>** in width and more than **[30 feet (9 m)] <Insert dimension>** in length.
  3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed **[1 cu. yd. (0.76 cu. m)] <Insert volume>** for bulk excavation or **[3/4 cu. yd. (0.57 cu. m)] <Insert volume>** for footing, trench, and pit excavation that cannot be removed by rock-excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a **42-inch- (1065-mm-)** maximum-width, short-tip-radius rock bucket; rated at not less than **138-hp (103-kW)** flywheel power with bucket-curling force of not less than **28,700 lbf (128 kN)** and stick-crowd force of not less than **18,400 lbf (82 kN)** with extra-long reach boom.
  2. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than **230-hp (172-kW)** flywheel power and developing a minimum of **47,992-lbf (213.3-kN)** breakout force with a general-purpose bare bucket.
- I. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material **[3/4 cu. yd. (0.57 cu. m)] <Insert volume>** or more in volume that exceed a standard penetration resistance of **[100 blows/2 inches (97 blows/50 mm)] <Insert value>** when tested by a geotechnical testing agency, according to ASTM D 1586.
- J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
- K. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.
- L. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.
- M. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- 1.5 PREINSTALLATION MEETINGS
- A. Preinstallation Conference: Conduct preexcavation conference at **[Project site] <Insert location>**.

1. Review methods and procedures related to earthmoving, including, but not limited to, the following:
  - a. Personnel and equipment needed to make progress and avoid delays.
  - b. Coordination of Work with utility locator service.
  - c. Coordination of Work and equipment movement with the locations of tree- and plant-protection zones.
  - d. Extent of trenching by hand or with air spade.
  - e. Field quality control.
  - f. **<Insert agenda items>**.

#### 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofam.
4. Warning tapes.

- B. Samples for Verification: For the following products, in sizes indicated below:

1. Geotextile: **12 by 12 inches (300 by 300 mm)**.
2. Warning Tape: **12 inches (300 mm)** long; of each color.

#### 1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified testing agency.

- B. Material Test Reports: For each [**on-site**] [**and**] [**borrow**] soil material proposed for fill and backfill as follows:

1. Classification according to ASTM D 2487.
2. Laboratory compaction curve according to [**ASTM D 698**] [**ASTM D 1557**].

- C. Blasting plan[ **approved by authorities having jurisdiction**].

- D. Seismic survey report from seismic survey agency.

- E. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Submit before earth moving begins.

#### 1.8 QUALITY ASSURANCE

- A. Blasting: Comply with applicable requirements in NFPA 495, "Explosive Materials Code," and prepare a blasting plan reporting the following:

1. Types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  2. Seismographic monitoring during blasting operations.
- B. Seismic Survey Agency: An independent testing agency, acceptable to authorities having jurisdiction, experienced in seismic surveys and blasting procedures to perform the following services:
1. Report types of explosive and sizes of charge to be used in each area of rock removal, types of blasting mats, sequence of blasting operations, and procedures that will prevent damage to site improvements and structures on Project site and adjacent properties.
  2. Seismographic monitoring during blasting operations.
- C. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

## 1.9 FIELD CONDITIONS

- A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
  2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
- B. Improvements on Adjoining Property: Authority for performing earth moving indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
1. Do not proceed with work on adjoining property until directed by Architect.
- C. Utility Locator Service: Notify [**utility locator service**] [**"Miss Utility"**] [**"Call Before You Dig"**] [**"Dig Safe System"**] [**"One Call"**] <Insert name> for area where Project is located before beginning earth-moving operations.
- D. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures specified in [**Section 015000 "Temporary Facilities and Controls"**] [**and**] [**Section 311000 "Site Clearing"**] are in place.
- E. Do not commence earth-moving operations until plant-protection measures specified in Section 015639 "Temporary Tree and Plant Protection" are in place.
- F. The following practices are prohibited within protection zones:
1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Foot traffic.
  4. Erection of sheds or structures.
  5. Impoundment of water.



6. Excavation or other digging unless otherwise indicated.
  7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
- G. Do not direct vehicle or equipment exhaust towards protection zones.
- H. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

## PART 2 - PRODUCTS

### 2.1 SOIL MATERIALS

- A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.
- B. Satisfactory Soils: Soil Classification [**Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487**] [**Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145**], or a combination of these groups; free of rock or gravel larger than [**3 inches (75 mm)**] <Insert dimension> in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
1. Liquid Limit: <Insert value>.
  2. Plasticity Index: <Insert value>.
- C. Unsatisfactory Soils: Soil Classification [**Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487**] [**Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145**], or a combination of these groups.
1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.
- D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a **1-1/2-inch (37.5-mm)** sieve and not more than 12 percent passing a **No. 200 (0.075-mm)** sieve.
- E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 294/D 2940M 0; with at least 95 percent passing a **1-1/2-inch (37.5-mm)** sieve and not more than 8 percent passing a **No. 200 (0.075-mm)** sieve.
- F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; with at least 90 percent passing a **1-1/2-inch (37.5-mm)** sieve and not more than 12 percent passing a **No. 200 (0.075-mm)** sieve.
- G. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940/D 2940M; except with 100 percent passing a **1-inch (25-mm)** sieve and not more than 8 percent passing a **No. 200 (0.075-mm)** sieve.
- H. Drainage Course: Narrowly graded mixture of [**washed**] crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a **1-1/2-inch (37.5-mm)** sieve and zero to 5 percent passing a **No. 8 (2.36-mm)** sieve.

- I. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and zero to 5 percent passing a No. 4 (4.75-mm) sieve.
- J. Sand: ASTM C 33/C 33M; fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

## 2.2 GEOTEXTILES

- A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
  - 2. Survivability: As follows:
    - a. Grab Tensile Strength: 157 lbf (700 N); ASTM D 4632.
    - b. Sewn Seam Strength: 142 lbf (630 N); ASTM D 4632.
    - c. Tear Strength: 56 lbf (250 N); ASTM D 4533.
    - d. Puncture Strength: 56 lbf (250 N); ASTM D 4833.
  - 3. Apparent Opening Size: [No. 40 (0.425-mm)] [No. 60 (0.250-mm)] [No. 70 (0.212-mm)] sieve, maximum; ASTM D 4751.
  - 4. Permittivity: [0.5] [0.2] [0.1] per second, minimum; ASTM D 4491.
  - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.
- B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  - 1. Survivability: Class 2; AASHTO M 288.
  - 2. Survivability: As follows:
    - a. Grab Tensile Strength: 247 lbf (1100 N); ASTM D 4632.
    - b. Sewn Seam Strength: 222 lbf (990 N); ASTM D 4632.
    - c. Tear Strength: 90 lbf (400 N); ASTM D 4533.
    - d. Puncture Strength: 90 lbf (400 N); ASTM D 4833.
  - 3. Apparent Opening Size: No. 60 (0.250-mm) sieve, maximum; ASTM D 4751.
  - 4. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  - 5. UV Stability: 50 percent after 500 hours' exposure; ASTM D 4355.

## 2.3 CONTROLLED LOW-STRENGTH MATERIAL

- A. Controlled Low-Strength Material: Self-compacting[, **low-density**], flowable concrete material produced from the following:
  - 1. Portland Cement: ASTM C 150/C 150M, [**Type I**] [**Type II**] [or] [**Type III**].

2. Fly Ash: ASTM C 618, Class C or F.
3. Normal-Weight Aggregate: ASTM C 33/C 33M, [**3/4-inch (19-mm)**] [**3/8-inch (10-mm)**] <Insert dimension> nominal maximum aggregate size.
4. Foaming Agent: ASTM C 869/C 869M.
5. Water: ASTM C 94/C 94M.
6. Air-Entraining Admixture: ASTM C 260/C 260M.

B. Produce low-density, controlled low-strength material with the following physical properties:

1. As-Cast Unit Weight: [**30 to 36 lb/cu. ft. (480 to 576 kg/cu. m)**] [**36 to 42 lb/cu. ft. (576 to 675 kg/cu. m)**] <Insert unit weight range> at point of placement, when tested according to ASTM C 138/C 138M.
2. Compressive Strength: [**80 psi (550 kPa)**] [**140 psi (965 kPa)**] <Insert value>, when tested according to ASTM C 495/C 495M.

C. Produce conventional-weight, controlled low-strength material with [**80-psi (550-kPa)**] [**140-psi (965-kPa)**] <Insert value> compressive strength when tested according to ASTM C 495/C 495M.

## 2.4 GEOFOAM

A. Extruded-Polystyrene Board Insulation: ASTM C 578, [**Type IV, 1.55-lb/cu. ft. (25-kg/cu. m) density, 25-psi (173-kPa) compressive strength**] [**Type X, 1.30-lb/cu. ft. (21-kg/cu. m) density, 15-psi (104-kPa) compressive strength**] [**Type VI, 1.80-lb/cu. ft. (29-kg/cu. m) density, 40-psi (276-kPa) compressive strength**] [**Type VII, 2.20-lb/cu. ft. (35-kg/cu. m) density, 60-psi (414-kPa) compressive strength**] [**Type V, 3.00-lb/cu. ft. (48-kg/cu. m) density, 100-psi (690-kPa) compressive strength**].

B. Molded-Polystyrene Board Insulation: ASTM C 578, [**Type I, 0.90-lb/cu. ft. (15-kg/cu. m) density, 10-psi (69-kPa) compressive strength**] [**Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m) density, 13-psi (90-kPa) compressive strength**] [**Type II, 1.35-lb/cu. ft. (22-kg/cu. m) density, 15-psi (104-kPa) compressive strength**].

1. Manufacture molded polystyrene with an inorganic mineral registered with the EPA and suitable for application as a termite deterrent.

C. Rigid Cellular Polystyrene Geof foam: ASTM D 6817, [**Type EPS 19, 1.15-lb/cu. ft. (18.4-kg/cu. m) density, 5.8-psi (40-kPa) compressive strength at 1 percent deformation; 16-psi (110-kPa) compressive strength at 10 percent deformation**] [**Type EPS 39, 2.40-lb/cu. ft. (38.4-kg/cu. m) density, 15-psi (103-kPa) compressive strength at 1 percent deformation; 40-psi (276-kPa) compressive strength at 10 percent deformation**] <Insert requirement>.

D. Connectors: [**Geof foam manufacturer's multibarbed, galvanized-steel sheet connectors**] [**Deformed steel reinforcing bars, 3/4 inch (19 mm) in diameter**] <Insert requirement>.

## 2.5 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, **6 inches (150 mm)** wide and **4 mils (0.1 mm)** thick, continuously inscribed with a description of the utility; colored as follows:
1. Red: Electric.
  2. Yellow: Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water systems.
  5. Green: Sewer systems.
- B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of **6 inches (150 mm)** wide and **4 mils (0.1 mm)** thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to **30 inches (750 mm)** deep; colored as follows:
1. Red: Electric.
  2. Yellow: Gas, oil, steam, and dangerous materials.
  3. Orange: Telephone and other communications.
  4. Blue: Water systems.
  5. Green: Sewer systems.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.
- B. Protect and maintain erosion and sedimentation controls during earth-moving operations.
- C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

### 3.2 DEWATERING

- A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

### 3.3 EXPLOSIVES

- A. Explosives: Do not use explosives.
- B. Explosives: Obtain written permission from authorities having jurisdiction before bringing explosives to Project site or using explosives on Project site.
  - 1. Perform blasting without damaging adjacent structures, property, or site improvements.
  - 2. Perform blasting without weakening the bearing capacity of rock subgrade and with the least-practicable disturbance to rock to remain.

### 3.4 EXCAVATION, GENERAL

- A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.
  - 1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
  - 2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
    - a. [24 inches (600 mm)] <Insert dimension> outside of concrete forms other than at footings.
    - b. [12 inches (300 mm)] <Insert dimension> outside of concrete forms at footings.
    - c. [6 inches (150 mm)] <Insert dimension> outside of minimum required dimensions of concrete cast against grade.
    - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    - e. [6 inches (150 mm)] <Insert dimension> beneath bottom of concrete slabs-on-grade.
    - f. [6 inches (150 mm)] <Insert dimension> beneath pipe in trenches and the greater of [24 inches (600 mm)] <Insert dimension> wider than pipe or [42 inches (1065 mm)] <Insert dimension> wide.
- B. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.
  - 1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.
    - a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.

2. Rock excavation includes removal and disposal of rock. Remove rock to lines and subgrade elevations indicated to permit installation of permanent construction without exceeding the following dimensions:
  - a. [24 inches (600 mm)] <Insert dimension> outside of concrete forms other than at footings.
  - b. [12 inches (300 mm)] <Insert dimension> outside of concrete forms at footings.
  - c. [6 inches (150 mm)] <Insert dimension> outside of minimum required dimensions of concrete cast against grade.
  - d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
  - e. [6 inches (150 mm)] <Insert dimension> beneath bottom of concrete slabs-on-grade.
  - f. [6 inches (150 mm)] <Insert dimension> beneath pipe in trenches and the greater of [24 inches (600 mm)] <Insert dimension> wider than pipe or [42 inches (1065 mm)] <Insert dimension> wide.

### 3.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
  1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
  2. Pile Foundations: Stop excavations 6 to 12 inches (150 to 300 mm) above bottom of pile cap before piles are placed. After piles have been driven, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.
  3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.
- B. Excavations at Edges of Tree- and Plant-Protection Zones:
  1. Excavate by hand or with an air spade to indicated lines, cross sections, elevations, and subgrades. If excavating by hand, use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  2. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.6 EXCAVATION FOR WALKS AND PAVEMENTS

- A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

### 3.7 EXCAVATION FOR UTILITY TRENCHES

- A. Excavate trenches to indicated gradients, lines, depths, and elevations.
  - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to **12 inches (300 mm)** higher than top of pipe or conduit unless otherwise indicated.
  - 1. Clearance: [**12 inches (300 mm) each side of pipe or conduit**] [**As indicated**].
- C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.
  - 1. For pipes and conduit less than **6 inches (150 mm)** in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
  - 2. For pipes and conduit **6 inches (150 mm)** or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
  - 3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
  - 4. Excavate trenches **6 inches (150 mm)** deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- D. Trench Bottoms: Excavate trenches **4 inches (100 mm)** deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.
  - 1. Excavate trenches **6 inches (150 mm)** deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.
- E. Trenches in Tree- and Plant-Protection Zones:
  - 1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
  - 2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.
  - 3. Cut and protect roots according to requirements in Section 015639 "Temporary Tree and Plant Protection."

### 3.8 EXCAVATION FOR ELEVATOR CYLINDER

- A. Drill well hole plumb in elevator pit to accommodate installation of elevator-cylinder assembly. Coordinate with applicable requirements for diameter and tolerances in [**Section 142400 "Hydraulic Elevators."**] [**Section 142413 "Hydraulic Freight Elevators."**]

- B. Provide well casing as necessary to retain walls of well hole.

### 3.9 SUBGRADE INSPECTION

- A. Notify Architect when excavations have reached required subgrade.
- B. If Architect determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
- C. Proof-roll subgrade [**below the building slabs and pavements**] <Insert locations> with a pneumatic-tired [**and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes)**] <Insert requirement> to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  - 1. Completely proof-roll subgrade in one direction[, **repeating proof-rolling in direction perpendicular to first direction**]. Limit vehicle speed to **3 mph (5 km/h)**.
  - 2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for [**unit prices**] [**changes in the Work**].
- E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect, without additional compensation.

### 3.10 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of **2500 psi (17.2 MPa)**, may be used when approved by Architect.
  - 1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

### 3.11 STORAGE OF SOIL MATERIALS

- A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
  - 1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

### 3.12 BACKFILL

- A. Place and compact backfill in excavations promptly, but not before completing the following:



1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

### 3.13 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within [**18 inches (450 mm)**] <Insert dimension> of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

D. Trenches under Roadways: Provide [**4-inch- (100-mm-)**] <Insert dimension> thick, concrete-base slab support for piping or conduit less than [**30 inches (750 mm)**] <Insert dimension> below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of [**4 inches (100 mm)**] <Insert dimension> of concrete before backfilling or placing roadway subbase course. Concrete is specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Initial Backfill:

1. Soil Backfill: Place and compact initial backfill of [**subbase material**] [**satisfactory soil**], free of particles larger than [**1 inch (25 mm)**] <Insert dimension> in any dimension, to a height of [**12 inches (300 mm)**] over the pipe or conduit.
  - a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.
2. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of [**12 inches (300 mm)**] over the pipe or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill:

1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.
  2. Controlled Low-Strength Material: Place final backfill of controlled low-strength material to final subgrade elevation.
- H. Warning Tape: Install warning tape directly above utilities, **12 inches (300 mm)** below finished grade, except **6 inches (150 mm)** below subgrade under pavements and slabs.

### 3.14 SOIL FILL

- A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.
- B. Place and compact fill material in layers to required elevations as follows:
1. Under grass and planted areas, use satisfactory soil material.
  2. Under walks and pavements, use satisfactory soil material.
  3. Under steps and ramps, use engineered fill.
  4. Under building slabs, use engineered fill.
  5. Under footings and foundations, use engineered fill.
- C. Place soil fill on subgrades free of mud, frost, snow, or ice.

### 3.15 GEOFOAM FILL

- A. Place a leveling course of sand, [**2 inches (50 mm)**] **<Insert dimension>** thick, over subgrade. Finish leveling course to a tolerance of **1/2 inch (13 mm)** when tested with a **10-foot (3-m)** straightedge.
1. Place leveling course on subgrades free of mud, frost, snow, or ice.
- B. Install geofoam blocks in layers with abutting edges and ends and with the long dimension of each block at right angles to blocks in each subsequent layer. Offset joints of blocks in successive layers.
- C. Install geofoam connectors at each layer of geofoam to resist horizontal displacement according to geofoam manufacturer's written instructions.
- D. Cover geofoam with [**subdrainage**] [**separation**] geotextile before placing overlying soil materials.

### 3.16 SOIL MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

### 3.17 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than **[8 inches (200 mm)]** <Insert dimension> in loose depth for material compacted by heavy compaction equipment and not more than **4 inches (100 mm)** in loose depth for material compacted by hand-operated tampers.
- B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.
- C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to **[ASTM D 698]** **[ASTM D 1557]**:
  1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches (300 mm)** of existing subgrade and each layer of backfill or fill soil material at **[95]** <Insert number> percent.
  2. Under walkways, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at **[92]** <Insert number> percent.
  3. Under turf or unpaved areas, scarify and recompact top **6 inches (150 mm)** below subgrade and compact each layer of backfill or fill soil material at **[85]** <Insert number> percent.
  4. For utility trenches, compact each layer of initial and final backfill soil material at **[85]** <Insert number> percent.

### 3.18 GRADING

- A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
  1. Provide a smooth transition between adjacent existing grades and new grades.
  2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.
- B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:
  1. Turf or Unpaved Areas: Plus or minus **[1 inch (25 mm)]** <Insert dimension>.
  2. Walks: Plus or minus **[1 inch (25 mm)]** <Insert dimension>.
  3. Pavements: Plus or minus **[1/2 inch (13 mm)]** <Insert dimension>.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of **[1/2 inch (13 mm)]** <Insert dimension> when tested with a **10-foot (3-m)** straightedge.

### 3.19 SUBSURFACE DRAINAGE

- A. Subdrainage Pipe: Specified in Section 334600 "Subdrainage."
- B. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a **6-inch (150-mm)** course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of **12 inches (300 mm)** of filter material, placed in compacted layers **6 inches (150 mm)** thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least **6 inches (150 mm)**.
  - 1. Compact each filter material layer [**to 85 percent of maximum dry unit weight according to ASTM D 698**] [**with a minimum of two passes of a plate-type vibratory compactor**].
- C. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within **12 inches (300 mm)** of final subgrade, in compacted layers **6 inches (150 mm)** thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least **6 inches (150 mm)**.
  - 1. Compact each filter material layer [**to 85 percent of maximum dry unit weight according to ASTM D 698**] [**with a minimum of two passes of a plate-type vibratory compactor**].
  - 2. Place and compact impervious fill over drainage backfill in **6-inch- (150-mm-)** thick compacted layers to final subgrade.

### 3.20 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

- A. Place subbase course[ **and base course**] on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place subbase course[ **and base course**] under pavements and walks as follows:
  - 1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  - 2. Place base course material over subbase course under hot-mix asphalt pavement.
  - 3. Shape subbase course[ **and base course**] to required crown elevations and cross-slope grades.
  - 4. Place subbase course[ **and base course**] **6 inches (150 mm)** or less in compacted thickness in a single layer.
  - 5. Place subbase course[ **and base course**] that exceeds **6 inches (150 mm)** in compacted thickness in layers of equal thickness, with no compacted layer more than **6 inches (150 mm)** thick or less than **3 inches (75 mm)** thick.
  - 6. Compact subbase course[ **and base course**] at optimum moisture content to required grades, lines, cross sections, and thickness to not less than [**95**] **<Insert number>** percent of maximum dry unit weight according to [**ASTM D 698**] [**ASTM D 1557**].
- C. Pavement Shoulders: Place shoulders along edges of subbase course[ **and base course**] to prevent lateral movement. Construct shoulders, at least **12 inches (300 mm)** wide, of satisfactory soil materials and compact simultaneously with each subbase[ **and base**] layer to

not less than [95] <Insert number> percent of maximum dry unit weight according to [ASTM D 698] [ASTM D 1557].

### 3.21 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

- A. Place drainage course on subgrades free of mud, frost, snow, or ice.
- B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:
  - 1. Install subdrainage geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
  - 2. Place drainage course 6 inches (150 mm) or less in compacted thickness in a single layer.
  - 3. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
  - 4. Compact each layer of drainage course to required cross sections and thicknesses to not less than [95] <Insert number> percent of maximum dry unit weight according to ASTM D 698.

### 3.22 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
  - 2. Determine that fill material classification and maximum lift thickness comply with requirements.
  - 3. Determine, during placement and compaction, that in-place density of compacted fill complies with requirements.
  - 4. <Insert special inspections>.
- B. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.
- C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.
- D. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.
- E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every [2000 sq. ft. (186 sq. m)] <Insert area> or less of paved area or building slab but in no case fewer than three tests.
  2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every [100 feet (30 m)] <Insert dimension> or less of wall length but no fewer than two tests.
  3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every [150 feet (46 m)] <Insert dimension> or less of trench length but no fewer than two tests.
- F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

### 3.23 PROTECTION

- A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.
- B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.
- C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.24 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.
- B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.
1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

## SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 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 temporary excavation support and protection systems.
- B. Related Requirements:
  - 1. Section 013233 "Photographic Documentation" for recording preexisting conditions and excavation support and protection system progress.
  - 2. Section 312000 "Earth Moving" for excavating and backfilling and for controlling surface-water runoff and ponding.
  - 3. Section 312319 "Dewatering" for dewatering excavations.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] <Insert location>**.
  - 1. Review geotechnical report.
  - 2. Review existing utilities and subsurface conditions.
  - 3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
  - 4. Review proposed excavations.
  - 5. Review proposed equipment.
  - 6. Review monitoring of excavation support and protection system.
  - 7. Review coordination with waterproofing.
  - 8. Review abandonment or removal of excavation support and protection system.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, performance properties, and dimensions of individual components and profiles, and calculations for excavation support and protection system.
- B. Shop Drawings: For excavation support and protection system, prepared by or under the supervision of a qualified professional engineer.
  - 1. Include plans, elevations, sections, and details.
  - 2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks, bracing, and other components of excavation support and protection system according to engineering design.
  - 3. Indicate type and location of waterproofing.
  - 4. Include a written plan for excavation support and protection, including sequence of construction of support and protection coordinated with progress of excavation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[land surveyor]** **[and]** **[professional engineer]**.
- B. Contractor Calculations: For excavation support and protection system. Include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Existing Conditions: Using **[photographs]** **[or]** **[video recordings]**, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by inadequate performance of excavation support and protection systems. Submit before Work begins.
- D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

#### 1.6 FIELD CONDITIONS

- A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
  - 1. Notify **[Architect]** **[Construction Manager]** **[Owner]** no fewer than **[two]** **<Insert number>** days in advance of proposed interruption of utility.
  - 2. Do not proceed with interruption of utility without **[Architect's]** **[Construction Manager's]** **[Owner's]** written permission.
- B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses



conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
  2. The geotechnical report is [**included**] [**referenced**] elsewhere in Project Manual.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Provide, [**design**], monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.
1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
  2. Prevent surface water from entering excavations by grading, dikes, or other means.
  3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
  4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

### 2.2 MATERIALS

- A. General: Provide materials that are either new or in serviceable condition.
- B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.
- C. Steel Sheet Piling: ASTM A 328/A 328M, ASTM A 572/A 572M, or ASTM A 690/A 690M; with continuous interlocks.
1. Corners: [**Site-fabricated mechanical interlock**] [**Roll-formed corner shape with continuous interlock**].
- D. Wood Lagging: Lumber, mixed hardwood, nominal rough thickness of [**size and strength required for application**] [**3 inches (75 mm)**] [**4 inches (100 mm)**] <Insert dimension>.
- E. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
- F. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.
- G. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (Grade 420)**, deformed.

- H. Tiebacks: Steel bars, ASTM A 722/A 722M.
- I. Tiebacks: Steel strand, ASTM A 416/A 416M.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.
  - 1. Shore, support, and protect utilities encountered.
- B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and used facilities.
  - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

### 3.2 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging. Accurately align exposed faces of flanges to vary not more than **[2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment]** <Insert tolerances>.
- B. Install wood lagging within flanges of soldier piles as excavation proceeds. Trim excavation as required to install lagging. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

### 3.3 SHEET PILING

- A. Before starting excavation, install one-piece sheet piling lengths and tightly interlock vertical edges to form a continuous barrier.
- B. Accurately place the piling, using templates and guide frames unless otherwise recommended in writing by the sheet piling manufacturer. Limit vertical offset of adjacent sheet piling to **60 inches (1500 mm)**. Accurately align exposed faces of sheet piling to vary not more than **[2 inches (50 mm) from a horizontal line and not more than 1:120 out of vertical alignment]** <Insert tolerances>.

- C. Cut tops of sheet piling to uniform elevation at top of excavation.

### 3.4 TIEBACKS

- A. Drill, install, grout, and tension tiebacks.
- B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.
  - 1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.
- C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.5 BRACING

- A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.
  - 1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.
  - 2. Install internal bracing if required to prevent spreading or distortion of braced frames.
  - 3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

### 3.6 FIELD QUALITY CONTROL

- A. Survey-Work Benchmarks: Resurvey benchmarks [**regularly**] [**daily**] [**weekly**] <Insert time period> during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.
- C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

### 3.7 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches (1200 mm) below overlying construction and abandon remainder.
  2. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
  3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.
- B. Leave excavation support and protection systems permanently in place.

END OF SECTION 315000

## SECTION 316213 - CONCRETE PILES

**TIPS:**

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To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section includes [**hollow**] [**solid**], precast, prestressed concrete piles.

## 1.3 UNIT PRICES

- A. Contract Sum: Base Contract Sum on number and dimensions of piles indicated from tip to cutoff, plus not less than **12 inches (305 mm)** of overlength for cutting piles at cutoff elevations.
- B. Work of this Section is affected as follows:
  - 1. Additional payment for pile lengths in excess of that indicated, and credit for pile lengths less than that indicated, is calculated at unit prices stated in the Contract, based on net addition or deduction to total pile length as determined by Architect and measured to nearest **12 inches (305 mm)**.
    - a. Additional payment for splices required to extend pile lengths in excess of that indicated is calculated at unit prices stated in the Contract.
  - 2. Additional payment for number of piles in excess of that indicated, and credit for number of piles less than that indicated, is calculated at unit prices stated in the Contract.
  - 3. Unit prices include labor, materials, tools, equipment, and incidentals for furnishing, driving, cutting off, capping, and disposing of cutoffs.
  - 4. Test piles that become part of permanent foundation system are considered as an integral part of the Work.
  - 5. No payment is made for rejected piles, including piles driven out of tolerance, defective piles, or piles damaged during handling or driving.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <**Insert location**>.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For concrete piles. Prepared by or under the supervision of a qualified professional engineer detailing fabrication and lifting devices necessary for handling and driving piles.
  - 1. Indicate pile dimensions, cross sections, locations, and sizes. Show details of pile splices and shoes.
  - 2. Indicate types of reinforcement, including prestressing strand, and detail fabricating, bending, and placing.
  - 3. Indicate layout and dimensions, and identify each pile. Indicate welded connections by AWS standard symbols. Detail cast-in hardware.
  - 4. Indicate transportation, storage, and lifting points.
  - 5. Include arrangement of static pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Delegated-Design Submittal: For concrete piles.
  - 1. Indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer]** **[manufacturer]** **[professional engineer]** **[and]** **[testing agency]**.
- B. Welding certificates.
- C. Design Mixes: For each concrete mix.
- D. Material Certificates: For **[steel reinforcements]** **[prestressing strand]** **[and]** **[concrete admixtures]**.
- E. Material Test Reports: For concrete materials.
- F. Pile-Driving Equipment Data: Include type, make, and rated energy range; weight of striking part of hammer; weight of drive cap; and, type, size, and properties of hammer cushion.
- G. Static Pile Test Reports: Submit within three days of completing each test.
- H. Pile-Driving Records: Submit within three days of driving each pile.

- I. Certified Piles Survey: Submit within [seven] <Insert number> days of pile driving completion.
- J. Field quality-control reports.
- K. Preconstruction Photographs: Photographs or video of existing conditions of adjacent construction. Submit before the Work begins.

## 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Engineering Responsibility: Assumes engineering responsibility to comply with requirements in "Performance Requirements" Article by engaging a qualified professional engineer to prepare design calculations, Shop Drawings, and other structural data for piles.
  - 2. PCI Plant Certification Program: Participates in PCI's Plant Certification Program and is designated a PCI-Certified Plant for [B2] [and] [C2] product group and category, or better.
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
  - 1. Installer's responsibility includes engaging a qualified professional engineer to prepare pile-driving records.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated[ **and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025**].
- D. Design Practices: Comply with **ACI 318 (ACI 318M)** and the recommendations in PCI Committee Report: "Recommended Practice for Design, Manufacture and Installation of Prestressed Concrete Piling."
- E. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for piles, comply with applicable requirements in PCI MNL-116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- F. Comply with requirements in ACI 301, "Specifications for Structural Concrete."
- G. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

## 1.8 PRECONSTRUCTION TESTING

- A. General: Static pile tests are used to verify driving criteria and pile lengths and to confirm allowable load of piles.

1. Furnish test piles [**60 inches (1524 mm)**] <Insert dimension> longer than production piles.
  2. Determination of actual length of piles is based on results of static pile tests.
- B. Pile Tests: Arrange and perform the following pile tests:
1. Axial Compressive Static Load Test: ASTM D 1143/D 1143M. Procedure A, Quick Test[ **and the following Procedures:**],[.]
    - a. Procedure B, Maintained Test.
    - b. Procedure C, Loading in Excess of Maintained Test.
    - c. Procedure G, Cyclic Loading Test.
  2. Axial Tension Static Load Test: ASTM D 3689.
  3. Lateral Load Test: ASTM D 3966.
- C. Equip each test pile with two telltale rods, according to ASTM D 1143/D 1143M, for measuring deformation during load test.
- D. Provide pile reaction frame, anchor piles, equipment, and instrumentation with enough reaction capacity to perform tests. Notify Architect at least 48 hours in advance of performing tests. On completion of testing, remove testing structure, anchor piles, equipment, and instrumentation.
1. Allow a minimum of [**seven**] <Insert number> days to elapse after driving test piles before starting pile testing.
  2. Number of Test Piles: [**One pile**] [**As indicated**] <Insert number>.
- E. Drive test piles at locations indicated to the minimum penetration or driving resistance indicated. Use test piles identical to those required for Project, and drive with appropriate pile-driving equipment operating at rated driving energy to be used in driving permanent piles.
1. Pile Design Load: [**As indicated**] <Insert load>.
- F. Approval Criteria: Allowable load shall be the load acting on the test pile when[ **the lesser of**] the following criteria are met, divided by a factor of safety of [**2**] <Insert value>:
1. Net settlement, after deducting rebound, of not more than **0.01 inch/ton (0.25 mm/907 kg)** of test load.
  2. Total settlement exceeds the pile elastic compression by **0.15 inch (4 mm)**, plus 1.0 percent of the tip diagonal dimension.
  3. A plunging failure or sharp break in the load settlement curve.
- G. Test Pile-Driving Records: Prepare driving records for each test pile[, **compiled and attested to by a qualified professional engineer**]. Include same data as required for driving records of permanent piles.
- H. Test piles that comply with requirements, including location tolerances, may be used on Project.



## 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piles to Project site in such quantities and at such times to ensure continuity of installation. Handle and store piles at Project site to prevent cracking, distorting, warping, or other physical damage, and so markings are visible.
- B. Lift and support piles only at designated lifting or supporting points as shown on Shop Drawings.

## 1.10 FIELD CONDITIONS

- A. Protect structures, underground utilities, and other construction from damage caused by pile driving.
- B. Site Information: A geotechnical report has been prepared for this Project and is **[included]** **[referenced]** elsewhere in the Project Manual for information only.
- C. Preconstruction Photographs: Inventory and record the condition of adjacent structures, underground utilities, and other construction. Document conditions that might be misconstrued as damage caused by pile driving. **[Comply with Section 013233 "Photographic Documentation."]**

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, **[provide products by the following]** **[provide products by one of the following]** **[available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:**
  - 1. **<Insert, in separate subparagraphs, manufacturer's name>.**

### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design piles, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Piles shall withstand transportation, erection, and driving stresses and design loads within limits indicated and under conditions existing at Project site.
  - 1. Design Loads: **<Insert loads>.**

### 2.3 MOLD MATERIALS

- A. Molds: Provide molds of metal, plastic, wood, or another material that is nonreactive with concrete and that produces required finish surfaces.

## 2.4 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (Grade 420)**; deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M.
- C. Galvanized Reinforcing Bars: ASTM A 767/A 767M, Class II zinc coated, hot-dip galvanized after fabrication and bending, as follows:
  - 1. Steel Reinforcement: [ASTM A 615/A 615M, **Grade 60 (Grade 420)**] [ASTM A 706/A 706M], deformed.
- D. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M or ASTM A 934/A 934M, as follows:
  - 1. Steel Reinforcement: [ASTM A 615/A 615M, **Grade 60 (Grade 420)**] [ASTM A 706/A 706M], deformed.
- E. Plain Steel Wire: ASTM A 82/A 82M, [as drawn] [galvanized].
- F. Deformed-Steel Wire: ASTM A 496/A 496M.
- G. Epoxy-Coated-Steel Wire: ASTM A 884/A 884M, Class A coated, [plain] [deformed].

## 2.5 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416/A 416M, **Grade 250 or 270 (Grade 1725 or 1860)**; uncoated, seven-wire, low-relaxation strand.

## 2.6 CONCRETE MATERIALS

- A. General: Limit water-soluble chloride ions in concrete to the maximum percentage by mass of cementitious material permitted by **ACI 318 (ACI 318M)**, but not more than 0.06 percent.
- B. Portland Cement: ASTM C 150/C 150M, [**Type I or Type III**] [**Type II**], of same type, brand, and source.
  - 1. Fly Ash: ASTM C 618, Class C or F.
  - 2. Silica Fume: ASTM C 1240, amorphous silica.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL-116, ASTM C 33/C 33M, with coarse aggregates complying with [**Class 4S**] [**Class 4M**] [**Class 1N**] <Insert class>. Provide aggregates from single source.
  - 1. Nominal Maximum Size of Aggregate: [**1 inch (25 mm)**] [**3/4 inch (19 mm)**].
- D. Water: Potable, free of deleterious material that may affect color stability, setting, or strength of concrete, and complying with chemical limits of PCI MNL-116.
- E. Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures.

1. Air-Entraining Admixture: ASTM C 260/C 26M.
2. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
3. Retarding Admixture: ASTM C 494/C 494M, Type B.
4. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
5. Water-Reducing and Accelerating Admixture: ASTM C 494/C 494M, Type E.
6. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
7. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
8. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

## 2.7 PILE ACCESSORIES

- A. Pile Shoes: **1-inch- (25-mm-)** thick minimum, carbon-steel plate fabricated to match shape of pile tip.
- B. Pile Splices: Manufactured from carbon-steel plates or castings and capable of developing strength of continuous pile at splice location.

## 2.8 CONCRETE MIXES

- A. Prepare design mixes for each type of concrete required.
  1. Limit use of fly ash and silica fume to not exceed, in total, **[25] <Insert number>** percent of portland cement by weight.
- B. Design mixes may be prepared by a qualified independent testing agency or by qualified personnel at precast manufacturing plant at precast manufacturer's option.
- C. Proportion mixes by either laboratory trial batch or field-test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
  1. Compressive Strength (28 Days): **[8000 psi (55.2 MPa)] [7000 psi (48.3 MPa)] [6000 psi (41.4 MPa)] [5000 psi (34.5 MPa)] <Insert value>**.
  2. Maximum Water-Cementitious Material Ratio: 0.40.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content of **[6.0 percent, plus or minus 1.5] [2.5 to 4.5]** percent.

## 2.9 FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete placement and temperature changes and for pretensioning and detensioning operations. Maintain molds to provide completed piles of shapes, lines, and dimensions indicated, within fabrication tolerances specified in PCI MNL-116 and PCI MNL-135.
  1. Unless molds are stripped before detensioning, design molds so stresses are not induced in piles due to deformation of concrete under prestress or movement during detensioning.
  2. Chamfer edges and corners of square piles.

- B. Reinforcement: Comply with recommendations in CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with concrete.
1. Accurately position, support, and secure reinforcement against displacement by molds, construction, or concrete placement. Locate and support reinforcement by metal chairs, runners, bolsters, spacers, and hangers, as required.
  2. Place reinforcement to obtain at least the minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- C. Prestress tendons for piles by either pretensioning or post-tensioning methods. Comply with PCI MNL-116.
- D. Pile Shoes: Accurately position and secure pile shoes at pile tips so as to not affect pile alignment during driving. Weld pile shoes to longitudinal reinforcements.
- E. Pile Splices: Accurately position and secure pile-splice segments requiring embedding in tips of piles.
- F. Mix concrete according to PCI MNL-116 and requirements in this Section. After initial concrete batching, no additional water may be added.
- G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in piles. Comply with requirements in PCI MNL-116 for measuring, mixing, transporting, and placing concrete.
1. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items. Use equipment and procedures complying with PCI MNL-116.
  2. Comply with ACI 306.1 procedures for cold-weather concrete placement.
  3. Comply with ACI 305R recommendations for hot-weather concrete placement.
- H. Identify pickup points of piles with permanent markings that correspond with markings indicated on Shop Drawings. Imprint casting date on each pile.
- I. Cure concrete, according to requirements in PCI MNL-116, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture.
- J. Delay detensioning piles until concrete has attained at least [70] <Insert number> percent of its compressive strength as established by test cylinders cured under the same conditions as concrete.
1. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
  2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat-cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
- K. Where ends of strands are not enclosed or covered, cut flush and cover with a high-strength mortar bonded to unit with an epoxy-resin bonding agent.

- L. Fabricate precast, prestressed concrete piles straight and true to size and shape with exposed edges and corners precise and true so each finished unit complies with PCI MNL-116 and PCI MNL-135 product tolerances.
- M. Finish: Fabricate concrete piles with normal plant-run finish produced in forms that impart a smooth finish to concrete. Small surface holes caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are tolerated. Major or unsightly imperfections, honeycombs, or structural defects are not permitted.
  - 1. Finish unformed surfaces by trowel unless otherwise indicated. Consolidate concrete, bring to proper level with straightedge, float, and trowel to a smooth, uniform finish.
- N. Pile-Length Markings: Mark each pile with horizontal lines at **12-inch (305-mm)** intervals; label the distance from pile tip at **60-inch (1524-mm)** intervals. Maintain markings on piles until driven.

## 2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to evaluate pile manufacturer's quality-control and testing methods.
  - 1. Allow Owner's testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with Owner's testing agency, and provide samples of materials and concrete mixes as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect piles according to PCI MNL-116.
  - 1. Strength of piles will be considered deficient if units fail to comply with requirements.
- C. If there is evidence that strength of piles may be deficient or may not comply with PCI MNL-116 requirements, Owner will employ an independent testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C 42/C 42M.
  - 1. A minimum of three representative cores shall be taken from piles of suspect strength, from locations directed by Architect.
  - 2. Cores shall be tested, following immersion in water, in a wet condition per ACI 301 if piles are wet under service conditions.
  - 3. Cores shall be tested in an air-dry condition per ACI 301 if piles are dry under service conditions.
  - 4. Strength of concrete for each series of three cores shall be considered satisfactory if average compressive strength is at least 85 percent of the 28-day design compressive strength and no core compressive strength is less than 75 percent of the 28-day design compressive strength.
  - 5. Test results shall be reported in writing on same day that tests are performed, with copies to Architect, Contractor, and pile manufacturer. Test reports shall include the following:
    - a. Project identification name and number.
    - b. Date when tests were performed.

- c. Name of precast concrete manufacturer.
  - d. Name of concrete testing agency.
  - e. Identification letter, name, and type of pile represented by core tests; design compressive strength; type of break; compressive strength at break, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- D. Patching: If core test results are satisfactory and piles comply with requirements, solidly fill core holes with patching mortar and finish to match adjacent pile surfaces.
- E. Piles will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Site Conditions: Do not start pile-driving operations until earthwork fills have been completed or excavations have reached an elevation of **6 to 12 inches (152 to 305 mm)** above bottom of footing or pile cap.

#### 3.2 DRIVING EQUIPMENT

- A. Pile Hammer: Air-, steam-, hydraulic-, or diesel-powered type capable of consistently delivering adequate peak-force duration and magnitude to develop the ultimate capacity required for type and size of pile driven and character of subsurface material anticipated.
- 1. Use pile hammer capable of adjustment to deliver reduced impact to maintain tensile stress within 70 percent of yield strength of pile reinforcement.
- B. Hammer Cushions and Driving Caps: Between hammer and top of pile, provide hammer cushion and steel driving cap as recommended by hammer manufacturer and as required to drive pile without damage.
- C. Leads: Use fixed, semifixed, or hanging-type pile-driver leads that hold the full length of pile firmly in position and in axial alignment with hammer.

#### 3.3 DRIVING PILES

- A. General: Continuously drive piles to elevations or penetration resistance indicated[ **or established by static load testing of piles**]. Establish and maintain axial alignment of leads and piles before and during driving.
- B. Predrilling: Provide pre-excavated holes where indicated, to depths indicated. Drill holes with a diameter less than the largest cross-section dimension of pile.

1. Firmly seat pile in predrilled hole by driving with reduced energy before starting final driving.
- C. Heaved Piles: Redrive heaved piles to tip elevation at least as deep as original tip elevation with a driving resistance at least as great as original driving resistance.
- D. Pile Splices: Splice piles during installation, and align pile segments concentrically.
- E. Driving Tolerances: Drive piles without exceeding the following tolerances, measured at pile heads:
  1. Location: 4 inches (102 mm) from location indicated after initial driving, and 6 inches (152 mm) after pile driving is completed.
  2. Plumb: Maintain 1 inch (25 mm) in 48 inches (1219 mm) from vertical, or a maximum of 4 inches (102 mm), measured when pile is aboveground in leads.
  3. Batter Angle: Maximum 1 inch (25 mm) in 48 inches (1219 mm) from required angle, measured when pile is aboveground in leads.
- F. Withdraw damaged or defective piles and piles that exceed driving tolerances, and install new piles within driving tolerances.
  1. Fill holes left by withdrawn piles using cohesionless soil material such as gravel, broken stone, and gravel-sand mixtures. Place and compact in lifts not exceeding 72 inches (1830 mm).
  2. Fill holes left by withdrawn piles as directed by Architect.
- G. Abandon and cut off rejected piles as directed by Architect. Leave rejected piles in place, and install new piles in locations as directed by Architect.
- H. Cut off tops of driven piles square with pile axis and at elevations indicated.
- I. Buildups: Construct buildups to elevations indicated of cast-in-place reinforced concrete with compressive strength not less than [5000 psi (34.5 MPa)] <Insert value> at 28 days.
- J. Pile-Driving Records: Maintain accurate driving records for each pile[, **compiled and attested to by a qualified professional engineer**]. Include the following data:
  1. Project name and number.
  2. Name of Contractor.
  3. Type of pile and date of casting.
  4. Pile location in pile group and designation of pile group.
  5. Sequence of driving in pile group.
  6. Pile dimensions.
  7. Ground elevation.
  8. Elevation of tips after driving.
  9. Final tip and cutoff elevations of piles after driving pile group.
  10. Records of re-driving.
  11. Elevation of splices.
  12. Type, make, model, and rated energy of hammer.
  13. Weight and stroke of hammer.
  14. Type of pile-driving cap used.

15. Cushion material and thickness.
16. Actual stroke and blow rate of hammer.
17. Pile-driving start and finish times, and total driving time.
18. Time, pile-tip elevation, and reason for interruptions.
19. Number of blows for every **12 inches (305 mm)** of penetration, and number of blows per **1 inch (25 mm)** for the last **6 inches (152 mm)** of driving.
20. Pile deviations from location and plumb.
21. Preboring, jetting, or special procedures used.
22. Unusual occurrences during pile driving.

K. Certified Piles Survey: Engage a **[land surveyor]** **[professional engineer]** to prepare a piles survey showing final location of piles in relation to the property survey and existing benchmarks.

1. Notify Architect when deviations from locations exceed allowable tolerances.

### 3.4 FIELD QUALITY CONTROL

A. Special Inspections: **[Owner will engage]** **[Engage]** a qualified special inspector to perform the following special inspections:

1. Pile foundations.
2. **<Insert special inspections>**.

B. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.

C. Tests and Inspections:

1. Dynamic Pile Testing: High-strain dynamic monitoring shall be performed and reported according to ASTM D 4945 during initial driving and during restriking on **[five single]** **[3 percent of]** **<Insert number or percent of>** piles.
2. Low-strain integrity measurement shall be performed and reported for each pile.

D. Piles will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

### 3.5 DISPOSAL

A. Remove withdrawn piles and cutoff sections of piles from site and legally dispose of them off Owner's property.

END OF SECTION 316213



## SECTION 316316 - AUGER CAST GROUT PILES

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 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 auger cast grout piles.

## 1.3 UNIT PRICES

- A. Contract Sum: Base Contract Sum on number and dimensions of piles from tip to pile top.
- B. Work of this Section is affected as follows:
  - 1. Pile Length: Additional payment for pile lengths in excess of that indicated, and credit for pile lengths less than that indicated, is calculated at unit prices stated in the Contract, based on net addition or deduction to total pile length as determined by Architect and measured to nearest **12 inches (305 mm)**.
  - 2. Number of Piles: Additional payment for number of piles in excess of that indicated, and credit for number of piles less than that indicated, is calculated at unit prices stated in the Contract.
  - 3. Unit prices include labor, materials, tools, equipment, and incidentals for excavation, grout fill, reinforcement, testing and inspection, and other items for complete pile installation.
  - 4. Test piles that become part of permanent foundation system are considered as an integral part of the Work.
  - 5. No payment is made for rejected piles, including piles out of specified tolerance or defective piles.
- C. Test Piles: Same unit price as indicated for production piles.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <**Insert location**>.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each grout mixture. Submit alternative 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.
- C. Shop Drawings: For auger cast grout piles, prepared by or under the supervision of a qualified professional engineer.
  - 1. Identify each pile and indicate pile dimensions, cross sections, locations, and sizes.
  - 2. Indicate types and configurations of reinforcement and detail fabricating.
  - 3. Detail connections to pile caps.
  - 4. Include method of centralizing reinforcement, type and size of centralizing devices, and locations on reinforcing bars.
  - 5. Static Pile Tests: Include arrangement of static test pile reaction frame, test and anchor piles, equipment, and instrumentation. Submit structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Welding certificates.
- C. Material Certificates: For the following:
  - 1. Cementitious materials.
  - 2. Concrete admixtures.
  - 3. Steel reinforcing.
- D. Equipment Data: Description of drilling and grout-pumping equipment including the following:
  - 1. Type and make of drilling rig, rated capacity, and boom lengths.
  - 2. Torque of drilling machine and horsepower of hydraulic power unit.
  - 3. Pressure and discharge capacity of grout pump.
  - 4. Automated monitoring equipment to be used.
- E. Static Pile Test Reports: Submit within three days of completing each test.
- F. Pile Inspection Reports: Submit not later than the morning of the next working day after placing each pile.

- G. Certified Piles Survey: Submit within [seven] <Insert number> days of completion.
- H. Field quality-control reports.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Record Drawings.
- B. Certified Pile Survey: Submit within seven days of pile installation completion.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1077, ASTM D 3740, and ASTM E 329 for testing indicated[ **and accredited by IAS or ILAC Mutual Recognition Arrangement as complying with ISO/IEC 17025**].
- B. Mix Designs: For each type of grout. Include description of type and proportions of ingredients.
- C. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.4/D1.4M, "Structural Welding Code - Reinforcing Steel."

#### 1.9 PRECONSTRUCTION TESTING

- A. Test Piles: Construct of diameter, depth, and at locations indicated on Drawings or, if not indicated, of same diameter and depth as largest production piles and at locations selected by Architect, to confirm allowable load of piles and demonstrate Installer's construction methods, equipment, standards of workmanship, and tolerances.
  - 1. If Architect determines that test pile does not comply with requirements, excavate for and cast another until it is accepted.
  - 2. Tests: Arrange and perform the following pile tests:
    - a. Axial Compressive Static Load Test: ASTM D 1143/D 1143M, Procedure A, Quick Test[ **and the following Procedures:**][.]
      - 1) Procedure B, Maintained Test.
      - 2) Procedure C, Loading in Excess of Maintained Test.
      - 3) Procedure G, Cyclic Loading Test.
    - b. Axial Tension Static Load Test: ASTM D 3689.
    - c. Lateral Load Test: ASTM D 3966.
  - 3. Equip each test pile with two telltale rods, according to ASTM D 1143/D 1143M, for measuring deformation during load test.
  - 4. Provide pile reaction frame, anchor piles, equipment, and instrumentation with enough reaction capacity to perform tests. Notify Architect at least 48 hours in advance of

performing tests. On completion of testing, remove testing structure, anchor piles, equipment, and instrumentation.

- a. Allow a minimum of [seven] <Insert number> days to elapse after installing test piles before starting pile testing.
  - b. Number of Test Piles: [One pile] [As indicated] <Insert number>.
5. Approval Criteria: Allowable load shall be the load acting on the test pile when[ **the lesser of**] the following criteria are met, divided by a factor of safety of [2] <Insert value>:
- a. Net settlement of not more than 0.01 inch/ton (0.25 mm/907 kg) of test load.
  - b. Total settlement of 1 inch (25 mm) provided the load settlement curve shows no sign of failure.
  - c. A plunging failure or sharp break in the load settlement curve.
6. Test Pile Records: Prepare records for each test pile[, **compiled and attested to by a qualified professional engineer**]. Include same data as required for permanent piles.
7. Test piles that comply with requirements, including location tolerances, may be used on Project.

#### 1.10 FIELD CONDITIONS

- A. Protect structures, underground utilities, and other construction from damage caused by pile excavation.
- B. Site Information: A geotechnical report has been prepared for this Project and is [included] [referenced] elsewhere in the Project Manual for information only.
- C. Survey Work: Engage a qualified land surveyor or professional engineer to perform surveys, layouts, and measurements for auger cast grout piles. Before excavating, lay out each pile to lines and levels required. Record actual measurements of each pile's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.
  1. Record and maintain information pertinent to each pile and indicate on record Drawings. Cooperate with Owner's testing and inspecting agency to provide data for required reports.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design piles, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  1. Design Loads: [As indicated on Drawings] <Insert loads>.

## 2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, **Grade 60 (Grade 420)**, deformed.
- B. Single Bar Reinforcing: ASTM A 722/A 722M, high strength, threaded.
  - 1. Mechanical Couplings: Screw-on type, capable of supporting the minimum ultimate tensile strength of the coupled bars.
- C. Centralizers: Devices to center steel reinforcement in excavation; spaced not less than **20 feet (6 m)** o.c. for vertical piles[ **and 10 feet (3 m) o.c. for battered piles**].

## 2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150/C 150M, [**Type I**] [**Type II**] [**Type I/II**] [**Type III**] [**Type V**].[ **Supplement with the following:**]
  - 1. Fly Ash: ASTM C 618, [**Class C**] [**Class F**].
- B. Fine Aggregate: ASTM C 33/C 33M with 100 percent passing a **No. 8 (2.36-mm)** sieve, free of materials with deleterious reactivity to alkali in cement. Provide aggregate from single source.
- C. Water: ASTM C 94/C 94M and potable.
- D. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures. Do not use calcium chloride or admixtures containing calcium chloride.
  - 1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  - 2. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  - 3. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  - 4. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- E. Fluidifier: ASTM C 937, with expansion of less than 4 percent.

## 2.4 RELATED MATERIALS

- A. Pile-Top Forms: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes. Provide units with enough wall thickness to resist plastic concrete loads without detrimental deformation. Diameter same as pile diameter.

## 2.5 GROUT MIXTURES

- A. Prepare design mixtures for each type and strength of grout, proportioned on the basis of laboratory trial mixture, field test data, or both.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Proportion grout mixture as follows:

1. Minimum Compressive Strength: [5000 psi (34.5 MPa)] [4500 psi (31 MPa)] [4000 psi (27.6 MPa)] <Insert value> at 28 days; ASTM C 109/C 109M with cube specimens restrained from expansion according to ASTM C 942.
2. Maximum Water-Cementitious Materials Ratio: [0.43] [0.38] <Insert ratio>.
3. Grout Flow: [10 to 25 seconds] <Insert flow rate>; ASTM C 939 and ASTM C 109/C 109M using a flow cone with 0.75-inch (19-mm) opening.

## 2.6 FABRICATING REINFORCEMENT

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

## 2.7 GROUT MIXING

- A. Ready-Mixed Grout: Measure, batch, mix, and deliver according to ASTM C 94/C 94M, and furnish batch ticket information.
  1. Temperature Limits: Comply with ACI 305.1 for hot weather and ACI 306.1 for cold weather.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, and other hazards created by drilling operations.
- B. Rough grade ground elevation at pile locations to a minimum of 12 inches (305 mm) above required cutoff elevation.

### 3.2 DRILLING AND PUMPING EQUIPMENT

- A. Drilling Rig: Capable of advancing hollow-stem, continuous-flight augers of design diameters to depths 20 percent greater than design depths; with stabilizing arm at bottom of leads to prevent rotation, and middle guide for augers greater than 40 feet (12 m) in length.
  1. Mark leads at maximum 60-inch (1500-mm) intervals to facilitate measurement of penetration.
- B. Hollow-Stem Auger: Continuous auger flighting without gaps or breaks, of diameter no more than 3 percent less than pile diameter; with grout pumping hole at bottom of auger head below cutting teeth. Seal grout-pumping hole with temporary tip plug to be fully opened by grout pressure or reinforcing bar during grout installation.
  1. Hollow Shaft Diameter: Minimum 1-1/4-inch (32-mm) clear ID.
- C. Grout Pump: Positive-displacement pump with a known volume per stroke. Minimum displacement pressure at pump of 350 lbf/sq. in. (2.4 MPa).

- D. Automated Monitoring Equipment: Capable of measuring auger depth, penetration rate, and grout volume pumped per unit depth increment and of printing results.

### 3.3 EXCAVATION

- A. Prevent surface water from entering excavated shafts. Conduct water to site drainage facilities.
- B. Advance auger at a continuous rate during insertion that prevents removal of excess soil.
- C. Excavate piles to [**elevations indicated**] [**auger refusal**] [**elevations indicated or auger refusal**]. Establish and maintain axial alignment of leads and shaft before and during driving.
  - 1. Auger Refusal: Rate of less than [**1 fpm (0.3 m/s)**] <Insert value>.
- D. Drilling Tolerances:
  - 1. Location: Pile centers maximum **3 inches (75 mm)** from locations indicated.
  - 2. Plumb: Within 2 percent from vertical.
  - 3. Batter Angle: Within 4 percent from required angle.

### 3.4 INSTALLATION

- A. Maintain positive (clockwise) rotation of auger during withdrawal. Promptly remove excavated spoils to prevent accumulation.
- B. Grout Placement: Place grout in continuous operation.
  - 1. Lift auger **6 to 12 inches (152 to 305 mm)** at start of grout pumping to facilitate tip plug removal, then return to previously established tip elevation.
  - 2. Develop an initial grout head of [**60 inches (1500 mm)**] <Insert dimension> before start of auger withdrawal and maintain during extraction.
  - 3. Monitor pumped grout volumes using automated monitoring equipment.
  - 4. Volume of placed grout is at least [**115**] <Insert number> percent of theoretical volume. If less than required volume is placed for any given **60-inch (1500-mm)** segment, lower auger a minimum of **60 inches (1500 mm)**, or to bottom of pile if less than **60 inches (1500 mm)** available, and restart withdrawal.
  - 5. If grout pumping is interrupted during placement, lower auger a minimum of **60 inches (1500 mm)**, or to bottom of pile if less than **60 inches (1500 mm)** available, and restart withdrawal.
- C. Steel Reinforcement Installation, General: Comply with recommendations in CRSI's "Manual of Standard Practice."
  - 1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy bond with grout.
  - 2. Screen pile top to remove spoils immediately after auger withdrawal and before placing reinforcement.
- D. Single Bar Reinforcing: Install through center of hollow-stem auger before grout placement.

- E. Reinforcing Cages: Install immediately after grout placement and support at ground surface until initial set. Allow cages to fall into shaft freely under their own weight; do not force by vibrating or pushing with mechanical equipment.
- F. Adjacent Piles: Do not install piles within [**6 pile diameters**] <Insert dimension> of piles grouted within the previous [**12**] <Insert duration> hours.
- G. Pile Completion:
  - 1. Where cutoff elevation is above the ground elevation, form top section above grade and extend shaft to required elevation with pile-top form.
  - 2. Where cutoff elevation is below the ground elevation, cut off top of piles at elevations indicated by removing fresh grout from the top of pile or cutting off hardened pile top after initial set.
- H. If location or out-of-plumb tolerances are exceeded, provide corrective construction. Submit corrective construction proposals to Architect for review before proceeding.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: [**Owner will engage**] [**Engage**] a qualified special inspector to perform the following special inspections:
  - 1. Pile excavation, placement, and testing.
  - 2. Steel reinforcement welding.
- B. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- C. Grout Tests: Testing of samples of fresh grout obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:
  - 1. Flow Rate: ASTM C 939 and ASTM C 109/C 109M using a flow cone with **0.75-inch (19-mm)** opening.
  - 2. Compressive Strength: ASTM C 109/C 109M with cube specimens restrained from expansion according to ASTM C 942.
    - a. Testing Frequency: Obtain [**six**] <Insert quantity> **2-inch (101-mm)** cubes for each **50 cu. yd. (38 cu. m)** or fraction thereof of grout placed, but not less than one set for each day's pour. Obtain an additional set of cubes from each truck during test pile placement.
    - b. Test two cubes at 7 days, two cubes at 28 days, and hold two cubes in reserve.
    - c. Strength of each grout mixture is satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than [**500 psi (3.4 MPa)**] <Insert value>.
    - d. Report test results in writing to Architect, grout manufacturer, and Contractor within 48 hours of testing. List Project identification name and number, date of placement, name of testing and inspecting agency, location of grout batch in Work, design compressive strength at 28 days, grout mixture proportions and materials,



- compressive breaking strength, and type of break for both 7- and 28-day tests in reports of compressive-strength tests.
- e. Additional Tests: Testing and inspecting agency to make additional tests of grout if test results indicate that compressive strengths or other requirements have not been met, as directed by Architect.
  - f. Perform additional testing and inspecting, at Contractor's expense, to determine compliance of replaced or additional work with specified requirements.
  - g. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Low-Strain Integrity Testing: Performed and reported according to ASTM D 5882 on **[five single] [3 percent of] <Insert number or percent of>** piles and reported for each pile.
- E. Pile Inspection Reports: Prepare inspection reports for each auger cast grout pile as follows:
- 1. Pile location.
  - 2. Pile diameter.
  - 3. Actual top and bottom elevations.
  - 4. Final top centerline location and deviations from requirements.
  - 5. Variation from plumb.
  - 6. Date and time of starting and completing.
  - 7. Position and condition of reinforcing steel and splices or mechanical couplings.
  - 8. Automatic monitoring equipment record including grout volume actually pumped.
  - 9. Grout testing results.
  - 10. Remarks, unusual conditions encountered, and deviations from requirements.
- F. Certified Piles Survey: Prepared by a qualified land surveyor or professional engineer showing final location of piles in relation to the property survey and existing benchmarks.
- 1. Notify Architect when deviations from locations exceed allowable tolerances.
- G. Auger cast grout piles will be considered defective if they do not pass tests and inspections.
- H. Prepare test and inspection reports.
- 3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS
- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 316316

## SECTION 321216 - ASPHALT PAVING

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Cold milling of existing asphalt pavement.
2. Hot-mix asphalt patching.
3. Hot-mix asphalt paving.
4. Hot-mix asphalt overlay.
5. Asphalt curbs.
6. Asphalt traffic-calming devices.
7. Asphalt surface treatments.

## B. Related Requirements:

1. [Section 024116 "Structure Demolition"] [and] [Section 024119 "Selective Demolition"] for demolition and removal of existing asphalt pavement.
2. Section 312000 "Earth Moving" for subgrade preparation, fill material, separation geotextiles, unbound-aggregate subbase and base courses, and aggregate pavement shoulders.
3. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
4. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.
5. Section 321400 "Unit Paving" for bituminous setting bed for pavers and for stone and precast concrete curbs.

## 1.3 UNIT PRICES

- A. Work of this Section is affected by <Insert name of unit price>.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:
    - a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
    - b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include technical data and tested physical and performance properties.
  2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.
  3. Job-Mix Designs: For each job mix proposed for the Work.
- B. Sustainable Design Submittals:
1. [<Double click to insert sustainable design text for recycled content.>](#)
- C. Samples for Verification: For the following product, in manufacturer's standard sizes unless otherwise indicated:
1. Paving Fabric: **12 by 12 inches** (300 by 300 mm) minimum.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[manufacturer]** **[and]** **[testing agency]**.
- B. Material Certificates: For each paving material. **[Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.]**
- C. Material Test Reports: For each paving material, by a qualified testing agency.
- D. Field quality-control reports.

#### 1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: **[A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located]** <Insert requirement>.
- B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

- C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of <Insert applicable standards> of <Insert name of state or local DOT> for asphalt paving work.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
  2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
  3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
  4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
  5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

## PART 2 - PRODUCTS

### 2.1 AGGREGATES

- A. General: Use materials and gradations that have performed satisfactorily in previous installations.
- B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.
- C. Fine Aggregate: [ASTM D 1073] [or] [AASHTO M 29], sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.
1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent by weight of the total aggregate mass.
- D. Mineral Filler: [ASTM D 242/D 242M] [or] [AASHTO M 17], rock or slag dust, hydraulic cement, or other inert material.

### 2.2 ASPHALT MATERIALS

- A. Asphalt Binder: [ASTM D 6373] [or] [AASHTO M 320] binder designation [PG 64-22] [PG 58-28] [PG 70-22] <Insert performance grade>.
- B. Asphalt Cement: [ASTM D 3381/D 3381M for viscosity-graded material] [ASTM D 946/D 946M for penetration-graded material].

- C. Cutback Prime Coat: ASTM D 2027/D 2027M, medium-curing cutback asphalt, [**MC-30 or MC-70**] [**MC-250**].
- D. Emulsified Asphalt Prime Coat: [**ASTM D 977**] [**or**] [**AASHTO M 140**] emulsified asphalt, or [**ASTM D 2397/D 2397M**] [**or**] [**AASHTO M 208**] cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- E. Tack Coat: [**ASTM D 977**] [**or**] [**AASHTO M 140**] emulsified asphalt, or [**ASTM D 2397/D 2397M**] [**or**] [**AASHTO M 208**] cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.
- F. Fog Seal: [**ASTM D 977**] [**or**] [**AASHTO M 140**] emulsified asphalt, or [**ASTM D 2397/D 2397M**] [**or**] [**AASHTO M 208**] cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- G. Water: Potable.
- H. Undersealing Asphalt: ASTM D 3141/D 3141M; pumping consistency.

### 2.3 AUXILIARY MATERIALS

- A. Recycled Materials for Hot-Mix Asphalt Mixes: Reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; and recycled [**tires**] [**asphalt shingles**] [**or**] [**glass**] from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.
- B. Herbicide: Commercial chemical for weed control, registered by the EPA, and not classified as "restricted use" for locations and conditions of application. Provide in granular, liquid, or wettable powder form.
- C. Sand: [**ASTM D 1073**] [**or**] [**AASHTO M 29**], Grade No. 2 or No. 3.
- D. Paving Geotextile: AASHTO M 288 paving fabric; nonwoven polypropylene; resistant to chemical attack, rot, and mildew; and specifically designed for paving applications.
- E. Joint Sealant: ASTM D 6690, [**Type I**] [**Type II or III**] [**Type IV**], hot-applied, single-component, polymer-modified bituminous sealant.

### 2.4 MIXES

- A. [<Double click to insert sustainable design text for recycled content.>](#)
  - 1. Surface Course Limit: Recycled content no more than [**10**] **<Insert number>** percent by weight.
- B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes [**approved by authorities having jurisdiction**] [**; designed according to procedures in AI MS-2, "Asphalt Mix Design Methods"**]; and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
  2. Base Course: <Insert mix designation>.
  3. Surface Course: <Insert mix designation>.
- C. Emulsified-Asphalt Slurry: ASTM D 3910, [Type 1] [Type 2] [Type 3].

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to begin paving.
- B. Proceed with paving only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.
- B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.
  1. Completely proof-roll subgrade in one direction[, **repeating proof-rolling in direction perpendicular to first direction**]. Limit vehicle speed to **3 mph (5 km/h)**.
  2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than **15 tons (13.6 tonnes)**.
  3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

### 3.3 COLD MILLING

- A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
  1. Mill to a depth of [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**] [**3 inches (75 mm)**] <Insert dimension>.
  2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
  3. Control rate of milling to prevent tearing of existing asphalt course.
  4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
  5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
  6. Patch surface depressions deeper than **1 inch (25 mm)** after milling, before wearing course is laid.

7. Handle milled asphalt material according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

### 3.4 PATCHING

- A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending **12 inches (300 mm)** into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseal concrete pieces firmly.
  1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseal pieces firmly.
  2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.
- C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of **0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m)**.
  1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
- D. Placing Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.
- E. Placing Patch Material: Partially fill excavated pavements with hot-mix asphalt base mix and, while still hot, compact. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.

### 3.5 REPAIRS

- A. Leveling Course: Install and compact leveling course consisting of hot-mix asphalt surface course to level sags and fill depressions deeper than **1 inch (25 mm)** in existing pavements.
  1. Install leveling wedges in compacted lifts not exceeding **3 inches (75 mm)** thick.
- B. Crack and Joint Filling: Remove existing joint filler material from cracks or joints to a depth of **[1/4 inch (6 mm)]** <Insert dimension>.
  1. Clean cracks and joints in existing hot-mix asphalt pavement.

2. Use emulsified-asphalt slurry to seal cracks and joints less than **1/4 inch (6 mm)** wide. Fill flush with surface of existing pavement and remove excess.
3. Use hot-applied joint sealant to seal cracks and joints more than **1/4 inch (6 mm)** wide. Fill flush with surface of existing pavement and remove excess.

### 3.6 SURFACE PREPARATION

- A. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
  1. Mix herbicide with prime coat if formulated by manufacturer for that purpose.
- C. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of **0.15 to 0.50 gal./sq. yd. (0.7 to 2.3 L/sq. m)**. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
  1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  2. Protect primed substrate from damage until ready to receive paving.
- D. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of **0.10 to 0.30 gal./sq. yd. per inch depth (0.5 to 1.40 L/sq. m per 25 mm depth)**. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
  1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
  2. Protect primed substrate from damage until ready to receive paving.
- E. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of **0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m)**.
  1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
  2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

### 3.7 PAVING GEOTEXTILE INSTALLATION

- A. Apply [**tack coat**] [**asphalt binder**] [**asphalt cement**] uniformly to existing pavement surfaces at a rate of **0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m)**.



- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints **4 inches (100 mm)** and transverse joints **6 inches (150 mm)**.
- C. Protect paving geotextile from traffic and other damage, and place hot-mix asphalt overlay the same day.

### 3.8 PLACING HOT-MIX ASPHALT

- A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
  - 1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
  - 2. Place hot-mix asphalt surface course in single lift.
  - 3. Spread mix at a minimum temperature of **250 deg F (121 deg C)**.
  - 4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
  - 5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.
- B. Place paving in consecutive strips not less than **10 feet (3 m)** wide unless infill edge strips of a lesser width are required.
  - 1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about **1 to 1-1/2 inches (25 to 38 mm)** from strip to strip to ensure proper compaction of mix along longitudinal joints.
  - 2. Complete a section of asphalt base course before placing asphalt surface course.
- C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

### 3.9 JOINTS

- A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
  - 1. Clean contact surfaces and apply tack coat to joints.
  - 2. Offset longitudinal joints, in successive courses, a minimum of **6 inches (150 mm)**.
  - 3. Offset transverse joints, in successive courses, a minimum of **24 inches (600 mm)**.
  - 4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints **[using either "bulkhead" or "papered" method according to AIMS-22, for both "Ending a Lane" and "Resumption of Paving Operations."]** **[as shown on Drawings.]** **<Insert joint requirement.>**
  - 5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.

6. Compact asphalt at joints to a density within 2 percent of specified course density.

### 3.10 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
  1. Complete compaction before mix temperature cools to **185 deg F (85 deg C)**.
- B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
  1. Average Density: 96 percent of reference laboratory density according to [ASTM D 6927] [or] [AASHTO T 245], but not less than 94 percent or greater than 100 percent.
  2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041/D 2041M, but not less than 90 percent or greater than 96 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.
- F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.11 ASPHALT CURBS

- A. Construct hot-mix asphalt curbs over compacted pavement surfaces. Apply a light tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of **250 deg F (121 deg C)**.
  1. Asphalt Mix: Same as pavement surface-course mix.

- B. Place hot-mix asphalt to curb cross section indicated or, if not indicated, to local standard shapes, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### 3.12 ASPHALT TRAFFIC-CALMING DEVICES

- A. Construct hot-mix asphalt speed [bumps] [humps] [cushions] [and] [tables] over compacted pavement surfaces. Apply a tack coat unless pavement surface is still tacky and free from dust. Spread mix at a minimum temperature of 250 deg F (121 deg C).
  - 1. Tack Coat Application: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m.).
  - 2. Asphalt Mix: Same as pavement surface-course mix.
  - 3. Before installation, mill pavement that will be in contact with bottom of traffic-calming device. Mill to a depth of 1 inch (25 mm) from top of pavement to a clean, rough profile.
- B. Place and compact hot-mix asphalt to cross section indicated, by machine or by hand in wood or metal forms. Tamp hand-placed materials and screed to smooth finish. Remove forms after hot-mix asphalt has cooled.

### 3.13 INSTALLATION TOLERANCES

- A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:
  - 1. Base Course: Plus or minus 1/2 inch (13 mm).
  - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.
- B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
  - 1. Base Course: [1/4 inch (6 mm)] <Insert dimension>.
  - 2. Surface Course: [1/8 inch (3 mm)] <Insert dimension>.
  - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).
- C. Asphalt Traffic-Calming Devices: Compact and form asphalt to produce the contour indicated and within a tolerance of plus or minus 1/8 inch (3 mm) of height indicated above pavement surface.

### 3.14 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.7 L/sq. m) to existing asphalt pavement and allow to cure. With fine sand, lightly dust areas receiving excess fog seal.
- B. Slurry Seals: Apply slurry coat in a uniform thickness according to ASTM D 3910 and allow to cure.

1. Roll slurry seal to remove ridges and provide a uniform, smooth surface.

### 3.15 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549/D 3549M.
- C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
- D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.
- E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to **[ASTM D 979/D 979M]** **[or]** **[AASHTO T 168]**.
  1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041/D 2041M, and compacted according to job-mix specifications.
  2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726/D 2726M.
    - a. One core sample will be taken for every **1000 sq. yd. (836 sq. m)** or less of installed pavement, with no fewer than three cores taken.
    - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726/D 2726M.
- F. Replace and compact hot-mix asphalt where core tests were taken.
- G. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

### 3.16 WASTE HANDLING

- A. General: Handle asphalt-paving waste according to approved waste management plan required in Section 017419 "Construction Waste Management and Disposal."

END OF SECTION 321216

## SECTION 321400 - UNIT PAVING

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Brick pavers set in **[aggregate] [bituminous] [and] [mortar]** setting beds.
2. Concrete pavers set in **[aggregate] [bituminous] [and] [mortar]** setting beds.
3. Asphalt-block pavers set in bituminous setting beds.
4. Stone pavers set in **[aggregate] [and] [mortar]** setting beds.
5. **[Plastic] [Steel] [Aluminum]** edge restraints.
6. Cast-in-place concrete edge restraints.
7. Precast concrete curbs.
8. Stone curbs.

## B. Related Requirements:

1. **[Section 075113 "Built-up Asphalt Roofing"] [Section 075116 "Built-up Coal Tar Roofing"] [Section 075213 "Atactic-Polypropylene (APP) Modified Bituminous Membrane Roofing"] [Section 075216 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing"] [Section 075316 "Chlorosulfonate-Polyethylene (CSPE) Roofing"] [Section 075323 "Ethylene-Propylene-Diene-Monomer (EPDM) Roofing"] [Section 075416 "Ketone Ethylene Ester (KEE) Roofing"] [Section 075419 "Polyvinyl-Chloride (PVC) Roofing"] [Section 075423 "Thermoplastic Polyolefin (TPO) Roofing"] [Section 075552.13 "Atactic-Polypropylene (APP) Modified Bituminous Protected Membrane Roofing"] [Section 075552.16 "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Protected Membrane Roofing"] [Section 075556 "Fluid-Applied Protected Membrane Roofing"]** for roof pavers.
2. Section 096313 "Brick Flooring" for brick flooring for interior applications.
3. Section 096340 "Stone Flooring" for dimension stone paving.
4. Section 321216 "Asphalt Paving" for asphalt base under unit pavers.

5. Section 321313 "Concrete Paving" **[for concrete base under unit pavers] [and] [for cast-in-place concrete curbs and gutters serving as edge restraints for unit pavers]**.
6. Section 321443 "Porous Unit Paving" for unit paving using grid pavers or pavers with openings between them.

### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site] <Insert location>**.

### 1.4 ACTION SUBMITTALS

- A. Product Data: For materials other than water and aggregates.
- B. Product Data: For the following:
  1. Pavers.
  2. Bituminous setting materials.
  3. Mortar and grout materials.
  4. Edge restraints.
  5. Precast concrete curbs.
  6. Granite curbs.
- C. Sustainable Design Submittals:
  1. [<Double click to insert sustainable design text for regional materials.>](#)
- D. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C 136.
- E. Samples for Initial Selection: For each type of unit paver indicated[.] **[and the following:]**
  1. Joint materials involving color selection.
  2. Exposed edge restraints involving color selection.
  3. Precast concrete curbs.
  4. Granite curbs.
- F. Samples for Verification: For full-size units of each type of unit paver indicated.[ **Assemble no fewer than five Samples of each type of unit on suitable backing and grout joints.**][ **Include Samples of the following:]**
  1. Joint materials.
  2. Exposed edge restraints.
  3. Precast concrete curbs.
  4. Granite curbs.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.

- B. Material Certificates: For unit pavers. Include statements of material properties indicating compliance with requirements, including compliance with standards. Provide for each type and size of unit.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for unit pavers, indicating compliance with requirements.
  - 1. For solid interlocking paving units, include test data for freezing and thawing according to ASTM C 67.

## 1.6 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Adhesion and Compatibility Testing: Submit to latex-additive manufacturer, for testing as indicated below, Samples of flooring materials that will contact or affect mortar and grout that contain latex additives.
  - 1. Use manufacturer's standard test methods to determine whether mortar and grout materials will obtain optimal adhesion with, and will be nonstaining to, installed brick and other materials constituting brick flooring installation.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store pavers on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Store liquids in tightly closed containers protected from freezing.
- E. Store asphalt cement and other bituminous materials in tightly closed containers.

## 1.9 FIELD CONDITIONS

- A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Bituminous Setting Bed:

1. Install bituminous setting bed only when ambient temperature is above 40 deg F (4 deg C) and when base is dry.
2. Apply asphalt adhesive only when ambient temperature is above 50 deg F (10 deg C) and when temperature has not been below 35 deg F (2 deg C) for 12 hours immediately before application. Do not apply when setting bed is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:

1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6. Provide artificial shade and windbreaks and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F (38 deg C) and higher.
  - a. When ambient temperature exceeds 100 deg F (38 deg C), or when wind velocity exceeds 8 mph (13 km/h) and ambient temperature exceeds 90 deg F (32 deg C), set pavers within 1 minute of spreading setting-bed mortar.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of unit paver, joint material, and setting material from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

### 2.2 BRICK PAVERS

- A. [<Double click to insert sustainable design text for brick.>](#)

- B. Brick Pavers: Light-traffic paving brick; ASTM C 902, Class SX [ or Class MX], [Type I] [Type II] [Type III], Application [PS] [PX] [PA]. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.

1. Thickness: [1-1/4 inches (32 mm)] [1-1/2 inches (38 mm)] [1-5/8 inches (41 mm)] [2-1/4 inches (57 mm)] [2-5/8 inches (67 mm)] [As indicated] <Insert dimension>.
2. Face Size: [3-3/4 by 7-1/2 inches (95 by 190 mm)] [3-5/8 by 7-5/8 inches (92 by 194 mm)] [3-5/8 by 11-5/8 inches (92 by 295 mm)] [7-5/8 by 7-5/8 inches (194 by 194 mm)] [4 by 8 inches (102 by 203 mm)] [4 by 12 inches (102 by 305 mm)] [8 by 8 inches (203 by 203 mm)] [As indicated] <Insert dimensions>.
3. Color: [Dark red] [Medium red] [Full-range red] [Dark brown] [Medium brown] [Full-range brown] [Tan] [Buff] [Cream] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.



- C. Brick Pavers: Heavy vehicular paving brick; ASTM C 1272, [Type F, Application PX] [Type R, Application PS] [Type R, Application PX] [Type R, Application PA]. Provide brick without frogs or cores in surfaces exposed to view in the completed Work.
1. Thickness: [2-1/4 inches (57 mm)] [2-5/8 inches (67 mm)] [As indicated] <Insert dimension>.
  2. Face Size: [3-3/4 by 7-1/2 inches (95 by 190 mm)] [3-5/8 by 7-5/8 inches (92 by 194 mm)] [3-5/8 by 11-5/8 inches (92 by 295 mm)] [7-5/8 by 7-5/8 inches (194 by 194 mm)] [4 by 8 inches (102 by 203 mm)] [4 by 12 inches (102 by 305 mm)] [8 by 8 inches (203 by 203 mm)] [As indicated] <Insert dimensions>.
  3. Color: [Dark red] [Medium red] [Full-range red] [Dark brown] [Medium brown] [Full-range brown] [Tan] [Buff] [Cream] [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
- D. Efflorescence: Brick shall be rated "not effloresced" when tested according to ASTM C 67.
- E. Temporary Protective Coating: Precoat exposed surfaces of brick pavers with a continuous film of a temporary protective coating that is compatible with brick, mortar, and grout products and can be removed without damaging grout or brick. Do not coat unexposed brick surfaces; handle brick to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.

### 2.3 CONCRETE PAVERS

- A. [<Double click to insert sustainable design text for regional materials.>](#)
- B. Concrete Pavers: Solid interlocking paving units complying with ASTM C 936/C 936M[ **and resistant to freezing and thawing when tested according to ASTM C 67**], made from normal-weight aggregates.
1. Thickness: [2-3/8 inches (60 mm)] [3-1/8 inches (80 mm)] <Insert dimension>.
  2. Face Size and Shape: [3-7/8 inches (98 mm)] [4-7/16 inches (113 mm)] [8-7/8 inches (225 mm)] [9 inches (229 mm)] square.
  3. Face Size and Shape: [3-7/8-by-7-7/8-inch (98-by-200-mm)] [4-by-8-inch (102-by-203-mm)] [4-7/16-by-8-7/8-inch (113-by-225-mm)] rectangle.
  4. Face Size and Shape: [5-1/2-inch (140-mm) octagon with attached 3-1/2-inch (89-mm) square] [4-1/2-by-9-inch (114-by-229-mm) rectangle with saw-tooth edges] [4-3/4-inch (121-mm) rectangular and trapezoidal units arranged in semicircular courses to produce fan-shaped pattern] [As indicated] <Insert dimensions and shape>.
  5. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
- C. Concrete Pavers: Solid paving units made from normal-weight concrete with a compressive strength not less than [5000 psi (34 MPa)] [6000 psi (41 MPa)] <Insert value>, water absorption not more than 5 percent according to ASTM C 140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C 67.

1. Thickness: [**1-5/8 inches (41 mm)**] [**1-3/4 inches (45 mm)**] [**2 inches (51 mm)**] [**2-3/8 inches (60 mm)**] <Insert dimension>.
  2. Face Size and Shape: [**8-7/8 inches (225 mm)**] [**9 inches (229 mm)**] [**12 inches (305 mm)**] [**18 inches (457 mm)**] [**24 inches (610 mm)**] square.
  3. Face Size and Shape: [**9-by-18-inch (229-by-457-mm)**] [**12-by-24-inch (305-by-610-mm)**] rectangle.
  4. Face Size and Shape: [As indicated] <Insert dimensions and shape>.
  5. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
- D. Concrete Pavers: Solid paving units complying with ASTM C 1491, made from lightweight concrete.
1. Thickness: [**1-5/8 inches (41 mm)**] [**1-3/4 inches (45 mm)**] [**2 inches (51 mm)**] <Insert dimension>.
  2. Face Size and Shape: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [As indicated] <Insert dimensions and shape>.
  3. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.

## 2.4 ASPHALT-BLOCK PAVERS

- A. Asphalt-Block Pavers: Solid units made from asphalt cement complying with ASTM D 312, Type III; inorganic stone dust or cement filler; and coarse aggregate, consisting of clean, hard, unweathered stone crushed into angular particles varying in size up to **3/8 inch (9.5 mm)**.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Thickness: [**1-1/4 inches (32 mm)**] [**2 inches (51 mm)**] [**3 inches (76 mm)**] <Insert dimension>.
  3. Face Size: [**4 by 6 inches (102 by 152 mm)**] [**6 by 6 inches (152 by 152 mm)**] [**8 by 8 inches (203 by 203 mm)**] [**5 by 12 inches (127 by 305 mm)**] [**6 by 12 inches (152 by 305 mm)**] [**8-inch- (203-mm-) wide hexagon**] <Insert dimensions>.
  4. Dimensional Tolerances: Plus or minus **1/16 inch (1.6 mm)**.
  5. Finish: [Natural, smooth] [Ground] [Ground and sandblasted].
  6. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.

## 2.5 STONE PAVERS

- A. [<Double click to insert sustainable design text for regional stone materials.>](#)
- B. Granite Pavers: Rectangular paving slabs made from granite complying with ASTM C 615/C 615M.
1. Color and Grain: [Light gray] [Dark gray] [Buff] [White] [Black] [Pink] <Insert color> with [medium] [fine] grain.
  2. Finish: [Honed] [Thermal] [As indicated] [Match Architect's sample] <Insert finish>.

3. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
  4. Thickness: Not less than [**3/4 inch (20 mm)**] [**30 mm**] [**1-1/4 inches (32 mm)**] [**1-5/8 inches (40 mm)**] unless otherwise indicated.
  5. Face Size: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [As indicated] <Insert dimensions>.
- C. Limestone Pavers: Rectangular paving slabs made from limestone complying with ASTM C 568/C 568M.
1. Classification: [**II Medium-Density**] [**III High-Density**].
  2. Stone Abrasion Resistance: Minimum value of [**10**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
  3. Indiana Oolitic Limestone Grade and Color: [**Select, buff**] [**Select, gray**] [**Standard, buff**] [**Standard, gray**] [**Rustic, buff**] [**Rustic, gray**] [**Variegated**], according to grade and color classification established by ILI.
  4. Finish: [**Smooth**] [**Chat sawed**] [**Shot sawed**] [**As indicated**] <Insert finish>.
  5. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
  6. Thickness: Not less than [**1 inch (25 mm)**] [**1-1/4 inches (32 mm)**] [**1-5/8 inches (40 mm)**] [**2 inches (50 mm)**] unless otherwise indicated.
  7. Face Size: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [As indicated] <Insert dimensions>.
- D. Marble Pavers: Rectangular paving slabs made from marble complying with ASTM C 503/C 503M.
1. Stone Abrasion Resistance: Minimum value of [**10**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
  2. Description: Uniform, fine- to medium-grained, [**white**] <Insert color> stone with only slight veining.
  3. Finish: [**Honed**] [**As indicated**] [**Match Architect's sample**] <Insert finish>.
  4. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
  5. Thickness: Not less than [**3/4 inch (20 mm)**] [**30 mm**] [**1-1/4 inches (32 mm)**] unless otherwise indicated.
  6. Face Size: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [As indicated] <Insert dimensions>.
- E. Quartz-Based Stone Pavers: [**Rectangular paving slabs**] [**Random polygonal flagstones**] made from quartz-based stone complying with ASTM C 616/C 616M, Classification [**I Sandstone**] [**II Quartzitic Sandstone**] [**III Quartzite**].
1. Stone Abrasion Resistance: Minimum value of [**10**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
  2. Finish: [**Sand rubbed**] [**Natural cleft**] [**Thermal**] [**As indicated**] [**Match Architect's sample**] <Insert finish>.
  3. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
  4. Thickness: Not less than [**1 inch (25 mm)**] [**1-1/4 inches (32 mm)**] [**1-1/2 inches (38 mm)**] [**1-5/8 inches (40 mm)**] [**2 inches (50 mm)**] unless otherwise indicated.

5. Face Size: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [As indicated] [Random] <Insert dimensions>.
- F. Slate Pavers: [**Rectangular paving slabs**] [**Random polygonal flagstones**] made from slate complying with ASTM C 629/C 629M, Classification I Exterior, with a fine, even grain[ **and unfading color,**] from clear, sound stock.
1. Color: [**Black**] [**Blue-black**] [**Gray**] [**Blue-gray**] [**Green**] [**Purple**] [**Mottled purple and green**] [**Red**].
  2. Stone Abrasion Resistance: Minimum value of [**8**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
  3. Finish: [**Honed**] [**Sand rubbed**] [**Natural cleft**] [As indicated] [**Match Architect's sample**] <Insert finish>.
  4. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
  5. Thickness: Not less than [**1/2 inch (13 mm)**] [**3/4 inch (20 mm)**] [**1 inch (25 mm)**] unless otherwise indicated.
  6. Face Size: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [As indicated] [Random] <Insert dimensions>.
- G. Travertine Pavers: Rectangular paving slabs made from travertine complying with ASTM C 1527/C 1527M, Classification I Exterior.
1. Stone Abrasion Resistance: Minimum value of [**10**] <Insert value>, based on testing according to ASTM C 241/C 241M or ASTM C 1353.
  2. Cut: Vein cut.
  3. Filling: Fill pores on faces of stone with cementitious filler of color [**selected by Architect**] [**matching Architect's sample**].
  4. Finish: [**Honed**] [As indicated] [**Match Architect's sample**] <Insert finish>.
  5. Match Architect's samples for color, finish, and other stone characteristics relating to aesthetic effects.
  6. Thickness: Not less than [**3/4 inch (20 mm)**] [**30 mm**] [**1-1/4 inches (32 mm)**] unless otherwise indicated.
  7. Face Size: [**9 inches (229 mm) square**] [**12 inches (305 mm) square**] [**18 inches (457 mm) square**] [**9 by 18 inches (229 by 457 mm)**] [As indicated] <Insert dimensions>.
- H. Rough Granite Pavers: Rectangular[ **tumbled**] paving stones, with split[ **or thermal-finished**] faces and edges, made from granite complying with ASTM C 615/C 615M.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Color and Grain: [**Light gray**] [**Dark gray**] [**Buff**] [**White**] [**Black**] [**Pink**] <Insert color> with [**medium**] [**fine**] grain.
  3. Thickness: [**1-1/4 inches (32 mm)**] [**2 inches (51 mm)**] [**3 inches (76 mm)**] [**4 inches (102 mm)**] [**4 inches (102 mm), plus or minus 1/2 inch (13 mm)**] <Insert dimension>.
  4. Face Size: [**4 by 4 inches (100 by 100 mm), plus or minus 1/2 inch (13 mm)**] [**3 to 5 inches (75 to 125 mm) by 8 to 12 inches (200 to 300 mm)**] [As indicated] <Insert dimensions>.

## 2.6 CURBS AND EDGE RESTRAINTS

- A. Plastic Edge Restraints: Manufacturer's standard triangular PVC extrusions [**1-3/4 inches (45 mm) high by 3-1/2 inches (89 mm) wide**] [**3-1/8 inches (79 mm) high by 9-1/2 inches (241 mm) wide**] designed to serve as edge restraints for unit pavers; rigid type for straight edges and flexible type for curved edges; with pipe connectors and **3/8-inch (9.5-mm)** diameter by **12-inch (300-mm)** long steel spikes.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Steel Edge Restraints: Manufacturer's standard painted steel edging [**3/16 inch (4.8 mm) thick by 4 inches (100 mm) high**] [**1/4 inch (6.4 mm) thick by 5 inches (125 mm) high**] with loops pressed from or welded to face to receive stakes at **36 inches (900 mm)** o.c. and steel stakes **15 inches (380 mm)** long for each loop.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
- C. Aluminum Edge Restraints: Manufacturer's standard [**straight, 1/8-inch (3.2-mm) thick by 4-inch (100-mm) high**] [**straight, 3/16-inch (4.8-mm) thick by 4-inch (100-mm) high**] [**L-shaped, 1/8-inch (3.2-mm) thick by 1-3/8-inch (35-mm) high**] [**L-shaped, 3/16-inch (4.8-mm) thick by 2-1/4-inch (57-mm) high**] extruded-aluminum edging with loops pressed from face to receive stakes at **12 inches (300 mm)** o.c. and aluminum stakes **12 inches (300 mm)** long for each loop.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. Job-Built Concrete Edge Restraints: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mixed concrete with minimum 28-day compressive strength of **3000 psi (20 MPa)**.
- E. Precast Concrete Curbs: Made from normal-weight concrete with a compressive strength not less than [**5000 psi (34 MPa)**] [**6000 psi (41 MPa)**] <Insert value> and water absorption not more than 5 percent, in shapes and sizes indicated.
1. [<Double click to insert sustainable design text for concrete curbs.>](#)
  2. Color and Texture: [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and texture>.
- F. Granite Curbs: Granite curbing, with face battered **1 inch per foot (1:12)**, produced in random lengths not less than **36 inches (900 mm)** from granite complying with ASTM C 615/C 615M.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. [<Double click to insert sustainable design text for stone.>](#)
  3. Granite Color and Grain: [**Light gray**] [**Dark gray**] [**Buff**] [**White**] [**Black**] [**Pink**] <Insert color> with [**fine**] [**medium**] [**coarse**] grain.
  4. Top Width: [**4 inches (102 mm)**] [**5 inches (127 mm)**] [**6 inches (152 mm)**] <Insert dimension>.
  5. Face Height: [**4 inches (102 mm)**] [**6 inches (152 mm)**] [**8 inches (203 mm)**] <Insert dimension>.

6. Total Height: [**12 inches (305 mm)**] [**16 inches (406 mm)**] [**18 inches (457 mm)**] **<Insert dimension>**.
7. Top Finish: [**Sawed**] [**Thermal**] [**Bush hammered**].
8. Face Finish: [**Split**] [**Sawed**] [**Thermal**] [**Bush hammered**].

## 2.7 ACCESSORIES

- A. Cork Joint Filler: Preformed strips complying with ASTM D 1752, Type II.
- B. Compressible Foam Filler: Preformed strips complying with ASTM D 1056, Grade 2A1.

## 2.8 AGGREGATE SETTING-BED MATERIALS

- A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with [**ASTM D 448 for Size No. 57**] [**ASTM D 2940/D 2940M, subbase material**] [**requirements in Section 312000 "Earth Moving" for subbase material**].
- B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with [**ASTM D 448 for Size No. 8**] [**ASTM D 2940/D 2940M, base material**] [**requirements in Section 312000 "Earth Moving" for base course**].
- C. Sand for Leveling Course: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.
- D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D 448 for Size No. 10.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing **No. 16 (1.18-mm)** sieve and no more than 10 percent passing **No. 200 (0.075-mm)** sieve.
  1. Provide sand of color needed to produce required joint color.
- F. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications; made from polyolefins or polyesters, with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  1. Survivability: Class 2, AASHTO M 288.
  2. Apparent Opening Size: **No. 60 (0.250-mm)** sieve, maximum; ASTM D 4751.
  3. Permittivity: 0.02 per second, minimum; ASTM D 4491.
  4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- G. Drainage Geotextile: Nonwoven needle-punched geotextile fabric, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:
  1. Survivability: Class 2, AASHTO M 288.
  2. Apparent Opening Size: **No. 40 (0.425-mm)** sieve, maximum; ASTM D 4751.
  3. Permittivity: 0.5 per second, minimum; ASTM D 4491.
  4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

- H. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

## 2.9 BITUMINOUS SETTING-BED MATERIALS

- A. Primer for Base: ASTM D 2028/D 2028M, cutback asphalt, grade as recommended by unit paver manufacturer.
- B. Fine Aggregate for Setting Bed: ASTM D 1073, No. 2 or No. 3.
- C. Asphalt Cement: ASTM D 3381/D 3381M, Viscosity Grade AC-10 or Grade AC-20.
- D. Neoprene-Modified Asphalt Adhesive: Paving manufacturer's standard adhesive consisting of oxidized asphalt combined with 2 percent neoprene and 10 percent long-fibered mineral fibers containing no asbestos.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing **No. 16 (1.18-mm)** sieve and no more than 10 percent passing **No. 200 (0.075-mm)** sieve.
  - 1. Provide sand of color needed to produce required joint color.

## 2.10 MORTAR SETTING-BED MATERIALS

- A. [<Double click to insert sustainable design text for mortar and grout.>](#)
- B. Portland Cement: ASTM C 150/C 150M, Type I or Type II.
- C. Hydrated Lime: ASTM C 207, Type S.
- D. Sand: ASTM C 144.
- E. Latex Additive: [**Manufacturer's standard**] [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed, and not containing a retarder.
- F. Thin-Set Mortar for Bond Coat: Latex-portland cement mortar complying with ANSI A118.4.
  - 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  - 2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
  - 3. Provide prepackaged, dry-mortar mix combined with [**acrylic resin**] [**or**] [**styrene-butadiene-rubber**] liquid-latex additive at Project site.
  - 4. Provide product that is approved by manufacturer for application thickness of [**5/8 inch (16 mm)**] **<Insert value>**.
- G. Water: Potable.

- H. Reinforcing Wire Fabric: Galvanized, welded wire fabric, **2 by 2 inches (50.8 by 50.8 mm)** by **0.062 inch (1.57 mm)** in diameter; comply with ASTM A 185/A 185M and ASTM A 82/A 82M except for minimum wire size.

## 2.11 GROUT MATERIALS

- A. [<Double click to insert sustainable design text for mortar and grout.>](#)
- B. Sand-Portland Cement Grout: ANSI A108.10, made of white or gray cement and white or colored aggregate as required to produce color indicated.
1. Colored Mortar Pigments for Grout: Natural and synthetic iron and chromium oxides, compounded for use in mortar and grout mixes. Use only pigments that have proved, through testing and experience, to be satisfactory for use in portland cement grout.
    - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Standard Cement Grout: ANSI A118.6, sanded.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- D. High-Performance Cement Grout: ANSI A118.7, sanded.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.
  3. Polymer Type: [**Acrylic resin**] [**or**] [**styrene-butadiene rubber**] in liquid-latex form for addition to prepackaged dry-grout mix.
- E. Grout Colors: [**As indicated by manufacturer's designations**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] <Insert color>.
- F. Water: Potable.

## 2.12 BITUMINOUS SETTING-BED MIX

- A. Mix bituminous setting-bed materials at an asphalt plant in approximate proportion, by weight, of 7 percent asphalt cement to 93 percent fine aggregate unless otherwise indicated. Heat mixture to **300 deg F (149 deg C)**.

## 2.13 MORTAR AND GROUT MIXES

- A. General: Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing times, and other procedures needed to produce setting-bed and joint materials of uniform quality and with optimal performance characteristics. Discard mortars and grout if they have reached their initial set before being used.



- B. Mortar-Bed Bond Coat: Mix neat cement and [**latex additive**] [**water**] to a creamy consistency.
- C. Portland Cement-Lime Setting-Bed Mortar: Type M complying with ASTM C 270, Proportion Specification.
- D. Latex-Modified, Portland Cement Setting-Bed Mortar: Proportion and mix portland cement, sand, and latex additive for setting bed to comply with written instructions of latex-additive manufacturer and as necessary to produce stiff mixture with a moist surface when bed is ready to receive pavers.
- E. Latex-Modified, Portland Cement Bond Coat: Proportion and mix portland cement, aggregate, and liquid latex for bond coat to comply with written instructions of liquid-latex manufacturer.
- F. Thinset Mortar Bond Coat: Proportion and mix according to manufacturer's written instructions.
- G. Job-Mixed Portland Cement Grout: Proportion and mix job-mixed portland cement and aggregate grout to match setting-bed mortar except omit hydrated lime and use enough water to produce a pourable mixture.
  - 1. Pigmented Grout: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment-to-cement ratio of 1 to 10, by weight.
  - 2. Colored-Aggregate Grout: Produce color required by combining colored aggregates with portland cement of selected color.
- H. Packaged Grout: Proportion and mix according to grout manufacturer's written instructions.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces indicated to receive unit paving, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Where unit paving is to be installed over waterproofing, examine waterproofing installation, with waterproofing Installer present, for protection from paving operations, including areas where waterproofing system is turned up or flashed against vertical surfaces.
- C. Proceed with installation only after unsatisfactory conditions have been corrected[ **and waterproofing protection is in place**].

### 3.2 PREPARATION

- A. Remove substances from concrete substrates that could impair mortar bond, including curing and sealing compounds, form oil, and laitance.
- B. Sweep concrete substrates to remove dirt, dust, debris, and loose particles.
- C. Proof-roll prepared subgrade according to requirements in Section 312000 "Earth Moving" to identify soft pockets and areas of excess yielding. Proceed with unit paver installation only after

deficient subgrades have been corrected and are ready to receive [subbase] [and] [base] course for unit pavers.

### 3.3 INSTALLATION, GENERAL

- A. Do not use unit pavers with chips, cracks, voids, discolorations, or other defects that might be visible or cause staining in finished work.
- B. Mix pavers from several pallets or cubes, as they are placed, to produce uniform blend of colors and textures.
- C. Cut unit pavers with motor-driven masonry saw equipment to provide clean, sharp, unchipped edges. Cut units to provide pattern indicated and to fit adjoining work neatly. Use full units without cutting where possible. Hammer cutting is not acceptable.
  - 1. For concrete pavers, a block splitter may be used.
- D. Handle protective-coated brick pavers to prevent coated surfaces from contacting backs or edges of other units. If, despite these precautions, coating does contact bonding surfaces of brick, remove coating from bonding surfaces before setting brick.
- E. Joint Pattern: [Running bond] [Herringbone] [Basket weave] [Grid] [As indicated] [Match and continue existing unit paver joint pattern].
- F. Pavers over Waterproofing: Exercise care in placing pavers and setting materials over waterproofing so protection materials are not displaced and waterproofing is not punctured or otherwise damaged. Carefully replace protection materials that become displaced and arrange for repair of damaged waterproofing before covering with paving.
  - 1. Provide joint filler at waterproofing that is turned up on vertical surfaces[ **unless otherwise indicated; where unfilled joints are indicated, provide temporary filler or protection until paver installation is complete**].
- G. Tolerances: Do not exceed **1/32-inch (0.8-mm)** unit-to-unit offset from flush (lippage) or **1/8 inch in 10 feet (3 mm in 3 m)** from level, or indicated slope, for finished surface of paving.
- H. Tolerances: Do not exceed[ **1/16-inch (1.6-mm) unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches (3 mm in 600 mm) and** ] **1/4 inch in 10 feet (6 mm in 3 m)** from level, or indicated slope, for finished surface of paving.
- I. Expansion and Control Joints: Provide for sealant-filled joints at locations and of widths indicated. Provide compressible foam filler as backing for sealant-filled joints[ **unless otherwise indicated; where unfilled joints are indicated, provide temporary filler until paver installation is complete**]. Install joint filler before setting pavers. Sealant materials and installation are specified in Section 079200 "Joint Sealants."
- J. Expansion and Control Joints: Provide cork joint filler at locations and of widths indicated. Install joint filler before setting pavers. Make top of joint filler flush with top of pavers.
- K. Provide edge restraints as indicated. Install edge restraints before placing unit pavers.

1. Install edge restraints to comply with manufacturer's written instructions. Install stakes at intervals required to hold edge restraints in place during and after unit paver installation.
  2. For metal edge restraints with top edge exposed, drive stakes at least **1 inch (25 mm)** below top edge.
  3. Install job-built concrete edge restraints to comply with requirements in Section 033000 "Cast-in-Place Concrete."
  4. Where pavers set in mortar bed are indicated as edge restraints for pavers set in aggregate setting bed, install pavers set in mortar and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.
  5. Where pavers embedded in concrete are indicated as edge restraints for pavers set in aggregate setting bed, install pavers embedded in concrete and allow concrete to cure before placing aggregate setting bed and remainder of pavers. Hold top of concrete below aggregate setting bed.
- L. Provide steps made of pavers as indicated. Install paver steps before installing adjacent pavers.
1. Where pavers set in mortar bed are indicated for steps constructed adjacent to pavers set in aggregate setting bed, install steps and allow mortar to cure before placing aggregate setting bed and remainder of pavers. Cut off mortar bed at a steep angle so it will not interfere with aggregate setting bed.

#### 3.4 AGGREGATE SETTING-BED APPLICATIONS

- A. Compact soil subgrade uniformly to at least **[95]** <Insert number> percent of **[ASTM D 698]** **[ASTM D 1557]** laboratory density.
- B. Proof-roll prepared subgrade to identify soft pockets and areas of excess yielding. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.
- C. Place separation geotextile over prepared subgrade, overlapping ends and edges at least **12 inches (300 mm)**.
- D. Place aggregate[ **subbase and**] base, compact by tamping with plate vibrator, and screed to depth indicated.
- E. Place aggregate[ **subbase and**] base, compact to 100 percent of ASTM D 1557 maximum laboratory density, and screed to depth indicated.
- F. Place drainage geotextile over compacted base course, overlapping ends and edges at least **12 inches (300 mm)**.
- G. Place leveling course and screed to a thickness of **1 to 1-1/2 inches (25 to 38 mm)**, taking care that moisture content remains constant and density is loose and uniform until pavers are set and compacted.
- H. Treat leveling course with herbicide to inhibit growth of grass and weeds.

- I. Set pavers with a minimum joint width of **1/16 inch (1.5 mm)** and a maximum of **1/8 inch (3 mm)**, being careful not to disturb leveling base. If pavers have spacer bars, place pavers hand tight against spacer bars. Use string lines to keep straight lines. Fill gaps between units that exceed [**3/8 inch (10 mm)**] <Insert dimension> with pieces cut to fit from full-size unit pavers.
  1. When installation is performed with mechanical equipment, use only unit pavers with spacer bars on sides of each unit.
- J. Vibrate pavers into leveling course with a low-amplitude plate vibrator capable of a **3500- to 5000-lbf (16- to 22-kN)** compaction force at 80 to 90 Hz. Use vibrator with neoprene mat on face of plate or other means as needed to prevent cracking and chipping of pavers. Perform at least three passes across paving with vibrator.
  1. Compact pavers when there is sufficient surface to accommodate operation of vibrator, leaving at least **36 inches (900 mm)** of uncompacted pavers adjacent to temporary edges.
  2. Before ending each day's work, compact installed concrete pavers except for **36-inch (900-mm)** width of uncompacted pavers adjacent to temporary edges (laying faces).
  3. As work progresses to perimeter of installation, compact installed pavers that are adjacent to permanent edges unless they are within **36 inches (90 mm)** of laying face.
  4. Before ending each day's work and when rain interrupts work, cover pavers that have not been compacted and cover leveling course on which pavers have not been placed with nonstaining plastic sheets to protect them from rain.
- K. Spread dry sand and fill joints immediately after vibrating pavers into leveling course. Vibrate pavers and add sand until joints are completely filled, then remove excess sand. Leave a slight surplus of sand on the surface for joint filling.
- L. Do not allow traffic on installed pavers until sand has been vibrated into joints.
- M. Repeat joint-filling process 30 days later.

### 3.5 BITUMINOUS SETTING-BED APPLICATIONS

- A. Apply primer to concrete slab or binder course immediately before placing setting bed.
- B. Prepare for setting-bed placement by locating **3/4-inch- (19-mm-)** deep control bars approximately **11 feet (3.3 m)** apart and parallel to one another, to serve as guides for striking board. Adjust bars to subgrades required for accurate setting of paving units to finished grades indicated.
- C. Place bituminous setting bed where indicated, in panels, by spreading bituminous material between control bars. Spread mix at a minimum temperature of **250 deg F (121 deg C)**. Strike setting bed smooth, firm, even, and not less than **3/4 inch (19 mm)** thick. Add fresh bituminous material to low, porous spots after each pass of striking board. After each panel is completed, advance first control bar to next position in readiness for striking adjacent panels. Carefully fill depressions that remain after removing depth-control bars.
  1. Roll setting bed with power roller to a nominal depth of **3/4 inch (19 mm)**. Adjust thickness as necessary to allow accurate setting of unit pavers to finished grades indicated. Complete rolling before mix temperature cools to **185 deg F (85 deg C)**.

- D. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling to a uniform thickness of **1/16 inch (1.6 mm)**. Proceed with setting of paving units only after adhesive is tacky and surface is dry to touch.
- E. Place pavers carefully by hand in straight courses, maintaining accurate alignment and uniform top surface. Protect newly laid pavers with plywood panels on which workers can stand. Advance protective panels as work progresses, but maintain protection in areas subject to continued movement of materials and equipment to avoid creating depressions or disrupting alignment of pavers. If additional leveling of paving is required, and before treating joints, roll paving with power roller after sufficient heat has built up in the surface from several days of hot weather.
- F. Joint Treatment: Place unit pavers with hand-tight joints. Fill joints by sweeping sand over paved surface until joints are filled. Remove excess sand after joints are filled.

### 3.6 MORTAR SETTING-BED APPLICATIONS

- A. Saturate concrete subbase with clean water several hours before placing setting bed. Remove surface water about one hour before placing setting bed.
- B. Apply mortar-bed bond coat over surface of concrete subbase about 15 minutes before placing mortar bed. Do not exceed **1/16-inch (1.6-mm)** thickness for bond coat. Limit area of bond coat to avoid its drying out before placing setting bed.
- C. Apply mortar bed over bond coat; spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- D. Place reinforcing wire over concrete subbase, lapped at joints by at least one full mesh and supported so mesh becomes embedded in the middle of mortar bed. Hold edges back from vertical surfaces approximately **1/2 inch (13 mm)**.
- E. Place mortar bed with reinforcing wire fully embedded in middle of mortar bed. Spread and screed mortar bed to uniform thickness at subgrade elevations required for accurate setting of pavers to finished grades indicated.
- F. Mix and place only that amount of mortar bed that can be covered with pavers before initial set. Before placing pavers, cut back, bevel edge, and remove and discard setting-bed material that has reached initial set.
- G. Wet brick pavers before laying if the initial rate of absorption exceeds **30 g/30 sq. in. (30 g/194 sq. cm)** per minute when tested according to ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.
- H. Place pavers before initial set of cement occurs. Immediately before placing pavers on mortar bed, apply uniform **1/16-inch- (1.5-mm-)** thick bond coat to mortar bed or to back of each paver with a flat trowel.
- I. Tamp or beat pavers with a wooden block or rubber mallet to obtain full contact with setting bed and to bring finished surfaces within indicated tolerances. Set each paver in a single

operation before initial set of mortar; do not return to areas already set or disturb pavers for purposes of realigning finished surfaces or adjusting joints.

- J. Spaced Joint Widths: Provide [3/8-inch (10-mm)] [1/2-inch (13-mm)] [3/4-inch (19-mm)] nominal joint width with variations not exceeding plus or minus [1/16 inch (1.5 mm)] [1/8 inch (3 mm)] [3/16 inch (4.5 mm)].
- K. Grouted Joints: Grout paver joints complying with ANSI A108.10.
- L. Grout joints as soon as possible after initial set of setting bed.
  - 1. Force grout into joints, taking care not to smear grout on adjoining surfaces.
  - 2. Clean pavers as grouting progresses by dry brushing or rubbing with dry burlap to remove smears before tooling joints.
  - 3. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
  - 4. If tooling squeezes grout from joints, remove excess grout and smears by dry brushing or rubbing with dry burlap and tool joints again to produce a uniform appearance.
- M. Cure grout by maintaining in a damp condition for seven days unless otherwise recommended by grout or liquid-latex manufacturer.

### 3.7 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace unit pavers that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Provide new units to match adjoining units and install in same manner as original units, with same joint treatment and with no evidence of replacement.
- B. Pointing: During tooling of joints, enlarge voids or holes and completely fill with grout. Point joints at sealant joints to provide a neat, uniform appearance, properly prepared for sealant application.
- C. Cleaning: Remove excess grout from exposed paver surfaces; wash and scrub clean.
  - 1. Remove temporary protective coating as recommended by coating manufacturer and as acceptable to paver and grout manufacturers.
  - 2. Do not allow protective coating to enter floor drains. Trap, collect, and remove coating material.

END OF SECTION 321400

## SECTION 321723 - PAVEMENT MARKINGS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on Masterworks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on Masterworks/Supporting Information.

## 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 painted markings applied to [**asphalt**] [**and**] [**concrete**] pavement.
- B. Related Requirements:
  - 1. Section 071800 "Traffic Coatings" for painting whole areas of building floors and pavements with coatings having an integral wearing surface.
  - 2. Section 099113 "Exterior Painting" for painting exterior concrete surfaces other than pavement.
  - 3. Section 099123 "Interior Painting" for painting interior concrete surfaces other than pavement.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.
  - 1. Review methods and procedures related to marking pavement including, but not limited to, the following:
    - a. Pavement aging period before application of pavement markings.
    - b. Review requirements for protecting pavement markings, including restriction of traffic during installation period.

## 1.4 ACTION SUBMITTALS

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

1. Include technical data and tested physical and performance properties.
- B. Shop Drawings: For pavement markings.
1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
  2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.
- C. Samples: For each exposed product and for each color and texture specified; on rigid backing, **8 inches (200 mm)** square.

## 1.5 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of **<Insert applicable standards>** of **<Insert name of state or local DOT>** for pavement-marking work.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of **[40 deg F (4.4 deg C) for alkyd materials]** **[55 deg F (12.8 deg C) for water-based materials]**, and not exceeding **95 deg F (35 deg C)**.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

### 2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in **[the USDOJ's "2010 ADA Standards for Accessible Design"]** **[the ABA standards of the Federal agency having jurisdiction]** **[and]** **[ICC A117.1]** **<Insert requirement>**.

### 2.3 PAVEMENT-MARKING PAINT

- A. Pavement-Marking Paint: Alkyd-resin type, lead and chromate free, ready mixed, complying with AASHTO M 248, **[Type N]** **[Type F]** **[Type S]**; colors complying with FS TT-P-1952.
1. Color: **[White]** **[Yellow]** **[Blue]** **[As indicated]** **<Insert color>**.



- B. Pavement-Marking Paint: MPI #32, solvent-borne traffic-marking paint.
  - 1. Color: [**White**] [**Yellow**] [**Blue**] [**As indicated**] <Insert color>.
- C. Pavement-Marking Paint: Latex, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952, Type II, with drying time of less than [**three**] [**45**] minutes.
  - 1. Color: [**White**] [**Yellow**] [**Blue**] [**As indicated**] <Insert color>.
- D. Pavement-Marking Paint: MPI #97, latex traffic-marking paint.
  - 1. Color: [**White**] [**Yellow**] [**Blue**] [**As indicated**] <Insert color>.
- E. Glass Beads: AASHTO M 247, Type 1[ **made of 100 percent recycled glass**].
  - 1. Roundness: Minimum [**75**] [**80**] percent true spheres by weight.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that pavement is dry and in suitable condition to begin pavement marking according to manufacturer's written instructions.
- B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

### 3.2 PAVEMENT MARKING

- A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect.
- B. Allow paving to age for a minimum of [**30**] [**90**] <Insert number> days before starting pavement marking.
- C. Sweep and clean surface to eliminate loose material and dust.
- D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of [**15 mils (0.4 mm)**] <Insert dimension>.
  - 1. Apply graphic symbols and lettering with paint-resistant, die-cut stencils, firmly secured to pavement. Mask an extended area beyond edges of each stencil to prevent paint application beyond stencil. Apply paint so that it cannot run beneath stencil.
  - 2. Broadcast glass beads uniformly into wet markings at a rate of **6 lb/gal. (0.72 kg/L)**.

### 3.3 PROTECTING AND CLEANING

- A. Protect pavement markings from damage and wear during remainder of construction period.

- B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION 321723

## SECTION 323113 - CHAIN LINK FENCES AND GATES

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

1. Chain-link fences.
2. Swing[, **motor-operated**] gates.
3. Horizontal-slide[, **motor-operated**] gates.
4. Privacy slats.

- B. Related Requirements:

1. [**Section 033000 "Cast-in-Place Concrete"**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete"**] for cast-in-place concrete [**equipment bases/pads for gate operators and controls**] [**and**] [**post footings**].
2. Section 281300 "Access Control" for gate controls.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1. Inspect and discuss electrical roughing-in, equipment bases, and other preparatory work specified elsewhere.
2. Review sequence of operation for each type of gate operator.
3. Review coordination of interlocked equipment specified in this Section and elsewhere.
4. Review required testing, inspecting, and certifying procedures.
5. <**Insert requirement**>.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Fence and gate posts, rails, and fittings.
    - b. Chain-link fabric, reinforcements, and attachments.
    - c. Accessories: [**Privacy slats**] [**Barbed wire**] [**Barbed tape**] <Insert item>.
    - d. Gates and hardware.
    - e. Gate operators, including operating instructions and motor characteristics.
- B. Shop Drawings: For each type of fence and gate assembly.
1. Include plans, elevations, sections, details, and attachments to other work.
  2. Include accessories, hardware, gate operation, and operational clearances.
  3. Gate Operator: Show locations and details for installing operator components, switches, and controls. Indicate motor size, electrical characteristics, drive arrangement, mounting, and grounding provisions.
  4. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For each type of factory-applied finish.
- D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
1. Polymer-Coated Components: In **6-inch (150-mm)** lengths for components and on full-sized units for accessories.
- E. Delegated-Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [**professional engineer**] [**testing agency**] [**factory-authorized service representative**].
- B. Product Certificates: For each type of chain-link fence, [**operator**], and gate.
- C. Product Test Reports: For framework strength according to ASTM F 1043, for tests performed by [**manufacturer and witnessed by a qualified testing agency**] [**or**] [**a qualified testing agency**].
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gate operators to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Testing Agency Qualifications: For testing fence grounding; member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Emergency Access Requirements: According to requirements of authorities having jurisdiction for gates with automatic gate operators serving as a required means of access.
- C. Mockups: Build mockups to set quality standards for fabrication and installation.
  - 1. Build mockup for typical chain-link fence[ **and gate**], including accessories.
    - a. Size: **[10-foot (3 m)]** <Insert dimension> length of fence.

## 1.8 FIELD CONDITIONS

- A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

## 1.9 WARRANTY

- A. Special Warranty: [**Manufacturer agrees**] [**Installer agrees**] to repair or replace components of chain-link fences and gates that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Failure to comply with performance requirements.
    - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
    - c. Faulty operation of gate operators and controls.
    - d. <Insert failure modes>.
  - 2. Warranty Period: [**Five**] [**15**] <Insert number> years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.
- B. Structural Performance: Chain-link fence and gate frameworks shall withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated according to [ASCE/SEI 7] <Insert requirement>.
1. Design Wind Load: [As indicated on Drawings] <Insert loads>.
    - a. Minimum Post Size: Determine according to ASTM F 1043 for post spacing not to exceed [10 feet (3 m)] <Insert dimension> for Material [Group IA, ASTM F 1043, Schedule 40 steel pipe] [Group IC, electric-resistance-welded round steel pipe] <Insert material group>.
    - b. Minimum Post Size and Maximum Spacing: Determine according to CLFMI WLG 2445, based on mesh size and pattern specified.
  - C. Lightning Protection System: Maximum resistance-to-ground value of 25 ohms at each grounding location along fence under normal dry conditions.

## 2.2 CHAIN-LINK FENCE FABRIC

- A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist according to "CLFMI Product Manual" and requirements indicated below:
1. Fabric Height: <Insert dimension> [As indicated on Drawings].
  2. Steel Wire for Fabric: Wire diameter of [0.192 inch (4.88 mm)] [0.148 inch (3.76 mm)] [0.120 inch (3.05 mm)] [0.113 inch (2.87 mm)] <Insert dimension>.
    - a. Mesh Size: [2-1/8 inches (54 mm)] [2 inches (50 mm)] [1-3/4 inches (44 mm)] [1 inch (25 mm)] <Insert dimension>.
    - b. Aluminum-Coated Fabric: ASTM A 491, Type I, [0.40 oz./sq. ft. (122 g/sq. m)] [0.35 oz./sq. ft. (107 g/sq. m)] [0.30 oz./sq. ft. (92 g/sq. m)].
    - c. Zinc-Coated Fabric: ASTM A 392, Type II, [Class 1, 1.2 oz./sq. ft. (366 g/sq. m)] [Class 2, 2.0 oz./sq. ft. (610 g/sq. m)] with zinc coating applied [before] [after] weaving.
    - d. Zn-5-Al-MM Aluminum-Mischmetal-Coated Fabric: ASTM F 1345, Type III, [Class 1, 0.60 oz./sq. ft. (183 g/sq. m)] [Class 2, 1.0 oz./sq. ft. (305 g/sq. m)].
    - e. Polymer-Coated Fabric: ASTM F 668, [Class 1] [Class 2a] [Class 2b] over [aluminum] [zinc] [Zn-5-Al-MM-alloy]-coated steel wire.
      - 1) Color: [Dark green] [Olive green] [Brown] [Black] [As selected by Architect from manufacturer's full range], according to ASTM F 934.

- f. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.
3. Aluminum Wire Fabric: ASTM F 1183, with [mill] [caustic-cleaned or etched] finish, and wire diameter of [0.148 inch (3.76 mm)] [0.192 inch (4.88 mm)].
  - a. Mesh Size: [2 inches (50 mm)] [1 inch (25 mm)].
4. Selvage: [Knuckled at both selvages] [Twisted top and knuckled bottom].

### 2.3 FENCE FRAMEWORK

- A. Posts and Rails <Insert drawing designation>: ASTM F 1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thickness according to ASTM F 1043 [or ASTM F 1083] based on the following:
  1. Fence Height: [72 inches (1830 mm)] [96 inches (2440 mm)] [As indicated on Drawings] <Insert dimension>.
  2. Light-Industrial-Strength Material: [Group IC-L, round steel pipe, electric-resistance-welded pipe] [Group II-L, roll-formed-steel C-section shapes] [Group III-L, hot-rolled H-beam shapes] [Group IV, Alternative Design].
    - a. Line Post: [1.9 inches (48 mm) in diameter] [2.375 inches (60 mm) in diameter] [2.875 inches (73 mm) in diameter] [2.25 by 1.7 inches (57 by 43 mm)] <Insert dimension(s)>.
    - b. End, Corner, and Pull Posts: [2.375 inches (60 mm)] [2.875 inches (73 mm)] [4.0 inches (102 mm)] [2.25 by 1.7 inches (57 by 43 mm)] <Insert dimension(s)>.
  3. Heavy-Industrial-Strength Material: [Group IA, round steel pipe, Schedule 40] [Group IC, round steel pipe, electric-resistance-welded pipe] [Group II, roll-formed-steel C-section shapes] [Group III, hot-rolled H-beam shapes] [Group IV, Alternative Design].
    - a. Line Post: [1.9 inches (48 mm) in diameter] [2.375 inches (60 mm) in diameter] [2.875 inches (73 mm) in diameter] [4.0 inches (102 mm) in diameter] [6.625 inches (168 mm) in diameter] [1.875 by 1.63 inches (48 by 41 mm)] [2.25 by 1.70 inches (57 by 43 mm)] [3.25 by 2.50 inches (83 by 64 mm)] <Insert dimension(s)>.
    - b. End, Corner, and Pull Posts: [2.375 inches (60 mm) in diameter] [2.875 inches (73 mm) in diameter] [4.0 inches (102 mm) in diameter] [6.625 inches (168 mm) in diameter] [2.25 by 1.70 inches (57 by 43 mm)] [3.25 by 2.50 inches (83 by 64 mm)] <Insert dimension(s)>.
  4. Horizontal Framework Members: [Intermediate] [top] [and] [bottom] rails according to ASTM F 1043.
    - a. Top Rail: [1.66 inches (42 mm) in diameter] [1.25 by 1.63 inches (32 by 41 mm)] <Insert dimension(s)>.
  5. Brace Rails: ASTM F 1043.

6. Metallic Coating for Steel Framework:
  - a. Type A: Not less than minimum **2.0-oz./sq. ft. (0.61-kg/sq. m)** average zinc coating according to ASTM A 123/A 123M or **4.0-oz./sq. ft. (1.22-kg/sq. m)** zinc coating according to ASTM A 653/A 653M.
  - b. Type B: Zinc with organic overcoat, consisting of a minimum of **0.9 oz./sq. ft. (0.27 kg/sq. m)** of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film.
  - c. External, Type B: Zinc with organic overcoat, consisting of a minimum of **0.9 oz./sq. ft. (0.27 kg/sq. m)** of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than **0.3-mil- (0.0076-mm-)** thick, zinc-pigmented coating.
  - d. Type C: Zn-5-Al-MM alloy, consisting of not less than **1.8-oz./sq. ft. (0.55-kg/sq. m)** coating.
  - e. Coatings: Any coating above.
7. Polymer coating over metallic coating.
  - a. Color: [**Match chain-link fabric**] [**Dark green**] [**Olive green**] [**Brown**] [**Black**] [**As selected by Architect from manufacturer's full range**], according to ASTM F 934.

## 2.4 TENSION WIRE

- A. Metallic-Coated Steel Wire: **0.177-inch- (4.5-mm-)** diameter, marcelled tension wire according to ASTM A 817 or ASTM A 824, with the following metallic coating:
  1. Type I: Aluminum coated (aluminized).
  2. Type II: Zinc coated (galvanized) by [**hot-dip**] [**electrolytic**] process, with the following minimum coating weight:
    - a. Class 3: Not less than **0.8 oz./sq. ft. (244 g/sq. m)** of uncoated wire surface.
    - b. Class 4: Not less than **1.2 oz./sq. ft. (366 g/sq. m)** of uncoated wire surface.
    - c. Class 5: Not less than **2 oz./sq. ft. (610 g/sq. m)** of uncoated wire surface.
    - d. Matching chain-link fabric coating weight.
  3. Type III: Zn-5-Al-MM alloy with the following minimum coating weight:
    - a. Class 60: Not less than **0.6 oz./sq. ft. (183 g/sq. m)** of uncoated wire surface.
    - b. Class 100: Not less than **1 oz./sq. ft. (305 g/sq. m)** of uncoated wire surface.
    - c. Matching chain-link fabric coating weight.
- B. Polymer-Coated Steel Wire: [**0.177-inch- (4.5-mm-)**] [**0.148-inch- (3.8-mm-)**] diameter, tension wire according to ASTM F 1664, [**Class 1**] [**Class 2a**] [**Class 2b**] over [**aluminum**] [**zinc**] [**Zn-5-Al-MM-alloy**]-coated steel wire.
  1. Color: [**Match chain-link fabric**] [**Dark green**] [**Olive green**] [**Brown**] [**Black**] [**As selected by Architect from manufacturer's full range**], according to ASTM F 934.



- C. Aluminum Wire: **0.192-inch- (4.88-mm-)** diameter tension wire, mill finished, according to **ASTM B 211 (ASTM B211M)**, Alloy 6061-T94 with **50,000-psi (344-MPa)** minimum tensile strength.

## 2.5 SWING GATES

- A. General: ASTM F 900 for gate posts and **[single] [double]** swing gate types.[ **Provide automated vehicular gates according to ASTM F 2200.**]
1. Gate Leaf Width: **[36 inches (914 mm)] [As indicated] <Insert width>**.
  2. Framework Member Sizes and Strength: Based on gate fabric height **[of 72 inches (1830 mm) or less] [of more than 72 inches (1830 mm)] [as indicated] <Insert dimension>**.
- B. Pipe and Tubing:
1. Zinc-Coated Steel: ASTM F 1043 and ASTM F 1083; **[protective coating and finish to match fence framework] [manufacturer's standard protective coating and finish] <Insert finish>**.
  2. Aluminum: ASTM B 429/B 429M; **[mill] [manufacturer's standard] <Insert finish>** finish.
  3. Gate Posts: **[Round tubular steel] [Rectangular tubular steel] [Round tubular aluminum] [Rectangular tubular aluminum]**.
  4. Gate Frames and Bracing: **[Round tubular steel] [Rectangular tubular steel] [Round tubular aluminum] [Rectangular tubular aluminum]**.
- C. Frame Corner Construction: **[Welded] [or] [assembled with corner fittings]**.
- D. Extended Gate Posts and Frame Members: Fabricate gate posts and frame end members to extend **[12 inches (300 mm)] [as indicated] <Insert dimension>** above top of chain-link fabric at both ends of gate frame to attach barbed **[wire] [tape]** assemblies.
- E. Hardware:
1. Hinges: **[180-degree inward] [180-degree outward] [360-degree inward and outward]** swing.
  2. Latch: Permitting operation from both sides of gate **[with provision for padlocking accessible from both sides of gate]**.
  3. Lock: **[Manufacturer's standard] <Insert requirement>** internal device.
  4. Padlock and Chain: **<Insert requirements>**.
  5. Closer: **[Manufacturer's standard] <Insert requirement>**.
  6. **<Insert hardware items and accessories>**.

## 2.6 HORIZONTAL-SLIDE GATES

- A. General: ASTM F 1184 for gate posts and **[single] [double]** sliding gate types.[ **Provide automated vehicular gates according to ASTM F 2200.**]
1. Classification: Type I Overhead Slide.

- a. Gate Leaf Width: **[As indicated]** <Insert width>.
  - b. Framework Member Sizes and Strength: Based on gate fabric height **[of 72 inches (1830 mm) or less]** **[of more than 72 inches (1830 mm)]** **[as indicated]** <Insert dimension>.
2. Classification: Type II Cantilever Slide, **[Class 1 with external]** **[Class 2 with internal]** roller assemblies.
    - a. Gate Frame Width and Height: **[48 inches (1220 mm) wide or less by 72 inches (1830 mm) high or less]** **[More than 48 inches (1220 mm) wide by any height]** **[As indicated]** <Insert dimension>.
- B. Pipe and Tubing:
1. Zinc-Coated Steel: **[Protective coating and finish to match fence framework]** **[Manufacturer's standard protective coating and finish]** <Insert finish>.
  2. Aluminum: ASTM B 429/B 429M; **[mill]** **[manufacturer's standard]** <Insert finish> finish.
  3. Gate Posts: ASTM F 1184. Provide **[round tubular steel]** **[rectangular tubular steel]** **[round tubular aluminum]** **[rectangular tubular aluminum]** posts.
  4. Gate Frames and Bracing: **[Round tubular steel]** **[Rectangular tubular steel]** **[Round tubular aluminum]** **[Rectangular tubular aluminum]**.
- C. Frame Corner Construction: **[Welded]** **[or]** **[assembled with corner fittings]**.
- D. Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame **[12 inches (300 mm)]** **[as indicated]** <Insert dimension> as required to attach barbed **[wire]** **[tape]** assemblies.
- E. Overhead Track Assembly: Manufacturer's standard track, with overhead framework supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.
- F. Hardware:
1. Hangers, Roller Assemblies, and Stops: Fabricated from **[galvanized steel]** **[galvanized malleable iron]** **[mill-finished Grade 319 aluminum-alloy casting with stainless-steel fasteners]**.
  2. Latch: Permitting operation from both sides of gate **[with provision for padlocking accessible from both sides of gate]**.
  3. Lock: **[Manufacturer's standard]** <Insert requirement> internal device.
  4. Padlock and Chain: <Insert requirements>.
  5. <Insert hardware items and accessories>.

## 2.7 FITTINGS

- A. Provide fittings according to ASTM F 626.
- B. Post Caps: Provide for each post.

1. Provide line post caps with loop to receive tension wire or top rail.
- C. Rail and Brace Ends: For each gate, corner, pull, and end post.
- D. Rail Fittings: Provide the following:
  1. Top Rail Sleeves: [**Pressed-steel or round-steel tubing**] [**Aluminum Alloy 6063**] not less than **6 inches (152 mm)** long.
  2. Rail Clamps: Line and corner boulevard clamps for connecting [**intermediate**] [**and**] [**bottom**] rails to posts.
- E. Tension and Brace Bands: [**Pressed steel**] [**Aluminum Alloy 6063**].
- F. Tension Bars: [**Steel**] [**Aluminum**] [**Fiberglass**], length not less than **2 inches (50 mm)** shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.
- G. Truss Rod Assemblies: [**Steel, hot-dip galvanized after threading**] [**Mill-finished aluminum**] rod and turnbuckle or other means of adjustment.
- H. Barbed Wire Arms: [**Pressed steel or cast iron**] [**Aluminum**], with clips, slots, or other means for attaching strands of barbed wire[, **and means for attaching to posts**] [, **integral with post cap**], for each post unless otherwise indicated, and as follows:
  1. Provide line posts with arms that accommodate top rail or tension wire.
  2. Provide corner arms at fence corner posts unless extended posts are indicated.
  3. Single-Arm Type: [**Type I, slanted arm**] [**Type II, vertical arm**].
  4. Double-Arm Type: [**Type III, V-shaped arm**] [**Type IV, A-shaped arm**].
- I. Tie Wires, Clips, and Fasteners: According to ASTM F 626.
  1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, according to the following:
    - a. Hot-Dip Galvanized Steel: [**0.106-inch- (2.69-mm-)**] [**0.148-inch- (3.76-mm-)**] diameter wire[; **galvanized coating thickness matching coating thickness of chain-link fence fabric**].
    - b. Aluminum: **ASTM B 211 (ASTM B 211M)**; Alloy 1350-H19; [**0.148-inch- (3.76-mm-)**] [**0.192-inch- (4.88-mm-)**] diameter, mill-finished wire.
- J. Finish:
  1. Metallic Coating for Pressed Steel or Cast Iron: Not less than **1.2 oz./sq. ft. (366 g/sq. m)** of zinc.
    - a. Polymer coating over metallic coating.
  2. Aluminum: Mill finish.

## 2.8 PRIVACY SLATS

- A. Fiber-Glass-Reinforced Plastic Slats: UV-light-stabilized fiber-glass-reinforced plastic, not less than **0.06 inch (1.5 mm)** thick, sized to fit mesh specified for direction indicated[, **with vandal-resistant fasteners and lock strips**].
- B. Tubular Polyethylene Slats: Minimum **0.023-inch (0.58-mm)**-thick tubular polyethylene, manufactured for chain-link fences from virgin polyethylene with UV inhibitor, sized to fit mesh specified for direction indicated, with [**vandal-resistant fasteners and lock strips**] [**fins for increased privacy factor**].
- C. Aluminum Slats: Minimum **0.01-inch (0.25-mm)**-thick aluminum, sized to fit mesh specified for direction indicated.
- D. Redwood Slats: **5/16-inch (7.9-mm)**-thick redwood, sized to fit mesh specified for direction indicated.
- E. Hedge-Type Slats: UV-light-stabilized[, **flame-resistant**], PVC "needles" woven into braided, galvanized wire core, sized to fit mesh specified for direction indicated.
- F. Color: [**As indicated by manufacturer's designations**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated on Drawings**] <Insert color>.

## 2.9 BARBED WIRE

- A. Steel Barbed Wire: ASTM A 121, two-strand barbed wire, **0.099-inch- (2.51-mm-)** diameter line wire with **0.080-inch- (2.03-mm-)** diameter, four-point round barbs spaced not more than **5 inches (127 mm)** o.c.
  - 1. Aluminum Coating: Type A.
  - 2. Zinc Coating: Type Z, Class 3.
- B. Polymer-Coated, Galvanized-Steel Barbed Wire: ASTM F 1665, two-strand barbed wire, **0.080-inch- (2.03-mm-)** diameter line wire with **0.080-inch- (2.03-mm-)** diameter, four-point, round [**aluminum alloy**] [**galvanized-steel**] barbs spaced not more than **5 inches (127 mm)** o.c.:
  - 1. Polymer Coating: [**Class 1**] [**Class 2a**] [**Class 2b**] over [**aluminum**] [**zinc**] [**Zn-5-Al-MM-alloy**]-coated steel wire.
    - a. Color: [**Match chain-link fabric**] [**Dark green**] [**Olive green**] [**Brown**] [**Black**] [**As selected by Architect from manufacturer's full range**] according to ASTM F 934.

## 2.10 BARBED TAPE

- A. Wire-Reinforced Tape: ASTM F 1910; continuous coils with four-point, needle-sharp barbs permanently cold clenched around a core wire.
  - 1. Core Wire: High-tensile-strength, [**zinc-coated steel**] [**or**] [**stainless steel**].

2. Configuration: [**Single**] [**Double**] coil.
  3. Style: [**Helical**] [**Concertina**] pattern.
  4. Coil Diameter(s): [**18-inch (457-mm)**] [**24 inches (610 mm)**] [**24-inch (610-mm) inner coil and 30-inch (762-mm) outer coil**] [As indicated on Drawings] <Insert diameter>.
  5. Coil Loop Spacing(s): [**12 inches (300 mm)**] [Manufacturer's standard] [As indicated on Drawings] <Insert spacing>.
  6. Barb Length Classification: [**Long, 1.2-inch (30.5-mm)**] [Medium, **0.4-inch (10.2-mm)**] [**Short, 0.1875-inch (4.76-mm)**] barb.
  7. Barb Spacing: [**4 inches (102 mm)**] <Insert dimension> o.c.
  8. Barb Set: [**Straight**] [**Offset**] [Manufacturer's standard].
- B. Clips: Stainless steel, **0.065 inch (1.7 mm)** thick by **0.375 inch (9.5 mm)** wide, capable of withstanding a minimum **150-lbf (667-N)** pull load to limit extension of coil, resulting in a concertina pattern when deployed.
- C. Tie Wires: Stainless steel, **0.065 inch (1.7 mm)** in diameter.

## 2.11 GATE OPERATORS

- A. Operators: Factory-assembled, automatic, gate-operating system designed for gate size, type, weight, and frequency of use. Control system shall have characteristics suitable for Project conditions, with control stations, safety devices, and weatherproof enclosures.
1. Operator design shall allow for removal of cover or motor without disturbing limit-switch adjustment and without affecting auxiliary emergency operation.
  2. Electronic components shall have built-in troubleshooting diagnostic feature.
  3. Unit shall be designed and wired for both right-hand/left-hand opening, permitting universal installation.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. UL Standard: Manufacture and label gate operators according to UL 325.
- D. Motors: Comply with NEMA MG 1.
1. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of **3300 feet (1000 m)** above sea level.
  2. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
  3. Service Factor: 1.15.
  4. Electrical Characteristics:
    - a. Horsepower: [**1**] [**2**] [**5**] <Insert horsepower>.
    - b. Voltage: [**115 V ac**] [**208 V ac**] [**230 V ac**], single phase, 60 hertz.
    - c. Voltage: [**208 V ac**] [**230 V ac**] [**460 V ac**], three phase, 60 hertz.
- E. Gate Operators: [**Gate**] [**Equipment base/pad**] [**Pedestal post**] [**In ground**] mounted and as follows:

1. Hydraulic **[Swing]** **[Slide]** Gate Operators:
  - a. Duty: **[Light]** **[Medium]** **[Heavy]** duty, **[residential]** **[commercial/industrial]**.
  - b. Gate Speed: Minimum **[45 feet (13.7 m)]** **[60 feet (18.2 m)]** per minute.
  - c. Maximum Gate Weight: **[300 lb (137 kg)]** **<Insert value>**.
  - d. Frequency of Use: **[10 cycles per hour]** **[25 cycles per hour]** **[60 cycles per hour]** **[Continuous duty]** **<Insert requirement>**.
  - e. Operating Type: **[Crank arm]** **[Wheel and rail drive]** **[Roller chain]**, **[with manual release]**.
  - f. Hydraulic Fluid: Of viscosity required for gate operation at ambient temperature range for Project.
  - g. Locking: Hydraulic in both directions.
  - h. Heater: Manufacturer's standard track and roller heater with thermostatic control.
  
2. Mechanical **[Swing]** **[Slide]** Gate Operators:
  - a. Duty: **[Light]** **[Medium]** **[Heavy]** duty, **[residential]** **[commercial/industrial]**.
  - b. Gate Speed: Minimum **[45 feet (13.7 m) per minute]** **[60 feet (18.2 m) per minute]** **[variable speed]** **<Insert requirement>**.
  - c. Maximum Gate Weight: **[600 lb (272 kg)]** **[800 lb (363 kg)]** **<Insert value>**.
  - d. Frequency of Use: **[10 cycles per hour]** **[25 cycles per hour]** **[60 cycles per hour]** **[Continuous duty]** **<Insert requirement>**.
  - e. Operating Type: **[Crank arm]** **[Wheel and rail drive]** **[Roller chain]**, **[with manual release]**.
  - f. Drive Type: Enclosed worm gear**[ and chain-and-sprocket]** reducers, roller-chain drive.
  - g. Drive Type: V-belt and **[worm gear]** **[chain-and-sprocket]** reducers, roller-chain drive.
  
- F. Controls: Electric controls separated from gate and motor and drive mechanism, with **[NEMA 250, Type 3R]** **[NEMA 250, Type 4]** **<Insert enclosure type>** enclosure for **[surface]** **[recessed or flush]** **[equipment base/pad]** **[pedestal]** **<Insert mounting>** mounting and with space for additional optional equipment.
  
- G. Control Devices:
  1. Control Station: Keyed, **[two]** **[three]**-position switch, located remotely from gate. Provide two keys per station.
    - a. Function: Open**[, stop,]** and close.
  2. Control Station: Momentary contact, **[single]** **[three]**-button operated; located remotely from gate.**[ Key switch to lock out open and close buttons.]**
    - a. Function: Open**[, stop,]** and close.
  3. Card Reader: Functions only when authorized card is presented. Programmable, magnetic **[multiple]** **[single]**-code system**[, permitting four different access time periods]** **[; face-lighted unit fully visible at night]**.
    - a. Reader Type: **[Touch plate]** **[Swipe]** **[Insertion]** **[Proximity]**.

- b. Features: [**Timed anti-passback**] [**Limited-time usage**] [**Capable of monitoring and auditing gate activity**].
4. Digital Keypad Entry Unit: Multiple-~~[programmable-]~~code capability of not less than [**five**] [**500**] [**2500**] **<Insert number>** possible individual codes, consisting of [**one- to seven**] [**four**] [**five**]-digit codes[, **and permitting four different access time periods**].
  - a. Features: [**Timed anti-passback**] [**Limited-time usage**] [**Capable of monitoring and auditing gate activity**].
  - b. Face-lighted unit with [**metal-keyed**] [**keyless-membrane**] keypad fully visible at night.
5. Radio Control: Digital system consisting of code-compatible universal receiver for each gate, located where indicated, with remote antenna with coaxial cable and mounting brackets designed to operate gates. Provide [**one**] [**two**] **<Insert number>** programmable transmitter(s) with multiple-code capability, permitting validating or voiding of not less than [**1000**] [**10,000**] **<Insert number>** codes per channel configured for the following functions:
  - a. Transmitters: [**Single**] [**Three**]-button operated, with open [**and close**] function.
  - b. Channel Settings: [**Two**] [**Three**] [**Four**] **<Insert number>** independent channel settings controlling separate receivers for operating more than one gate from each transmitter.
6. Telephone Entry System: Hands-free voice-communication system for connection to building telephone system, with digital-entry code activation of gate operator[ **and auxiliary keypad entry**].
  - a. Residential System: Designed to be wired to same line with telephone.
  - b. Multiunit System: Designed to be wired to a dedicated telephone line, with capacity to access [**20**] [**100**] **<Insert number>** telephones[ **and with electronic directory**].
7. Vehicle Loop Detector: System that includes automatic closing timer with adjustable time delay before closing[, **timer cut-off switch,**] and loop detector designed to [**open and close gate**] [**hold gate open until traffic clears**] [**reverse gate**] **<Insert functions>**. Provide electronic detector with adjustable detection patterns, adjustable sensitivity and frequency settings, and panel indicator light designed to detect presence or transit of a vehicle over an embedded loop of wire and to emit a signal activating the gate operator. Provide number of loops consisting of multiple strands of wire, number of turns, loop size, and method of placement at location shown on Drawings, and as recommended in writing by detection system manufacturer for function indicated.
  - a. Loop: [**Field-assembled**] [**Factory-preformed**] wire, in size indicated, for [**pave-over**] [**saw-cut and epoxy-grouted**] installation.
8. Vehicle Presence Detector: System that includes automatic closing timer with adjustable time delay before closing[, **timer cut-off switch,**] and presence detector designed to [**open and close gate**] [**hold gate open until traffic clears**] [**reverse gate**] **<Insert functions>**.

- a. Provide [**retroreflective**] [**emitter/receiver**] detector with adjustable detection zone pattern and sensitivity, designed to detect the presence or transit of a vehicle in gate pathway when infrared beam in zone pattern is interrupted, and to emit a signal activating the gate operator.
- H. Obstruction Detection Devices: Provide each motorized gate with automatic safety sensor(s). Activation of sensor(s) causes operator to immediately function as follows:
1. Action: [**Reverse gate in both opening and closing cycles and hold until clear of obstruction**] [**Stop gate in opening cycle and reverse gate in closing cycle and hold until clear of obstruction**].
  2. Internal Sensor: Built-in torque or current monitor senses gate is obstructed.
  3. Sensor Edge: Contact-pressure-sensitive safety edge, profile, and sensitivity designed for type of gate and component indicated, in locations as follows. Connect to control circuit using [**take-up cable reel**] [**self-coiling cable**] [**gate edge transmitter and operator receiver system**].
    - a. Along entire gate leaf leading edge.
    - b. Along entire gate leaf trailing edge.
    - c. Across entire gate leaf bottom edge.
    - d. Along entire length of gate posts.
    - e. Along entire length of gate guide posts.
    - f. Where indicated on Drawings.
    - g. <**Insert extent and location**>.
  4. Photoelectric/Infrared Sensor: Designed to detect an obstruction in gate's path when infrared beam in the zone pattern is interrupted.
- I. Limit Switches: Adjustable switches, interlocked with motor controls and set to automatically stop gate at fully open and fully closed positions.
- J. Emergency Release Mechanism: Quick-disconnect release of operator drive system, permitting manual operation if operator fails. Control circuit power is disconnected during manual operation.
1. Type: [**Integral fail-safe release, allowing gate to be pushed open without mechanical devices, keys, cranks, or special knowledge**] [**Mechanical device, key, or crank-activated release**].
- K. Operating Features:
1. Digital Microprocessor Control: Electronic programmable means for setting, changing, and adjusting control features[ **with capability for monitoring and auditing gate activity**]. Provide unit that is isolated from voltage spikes and surges.
  2. System Integration: With controlling circuit board capable of accepting any type of input from external devices.
  3. Master/Slave Capability: Control stations designed and wired for gate pair operation.
  4. Automatic Closing Timer: With adjustable time delay before closing[ **and timer cut-off switch**].
  5. Open Override Circuit: Designed to override closing commands.



6. Reversal Time Delay: Designed to protect gate system from shock load on reversal in both directions.
7. Maximum Run Timer: Designed to prevent damage to gate system by shutting down system if normal time to open gate is exceeded.
8. Clock Timer: [24 hour] [Seven day] <Insert time period>, programmable for regular events.

L. Accessories:

1. Warning Module: [Audio] [Visual], [constant] [strobe]-light alarm sounding three to five seconds in advance of gate operation and continuing until gate stops moving.
2. Battery Backup System: Battery-powered drive and access-control system, independent of primary drive system.
  - a. Fail Safe: Gate opens and remains open until power is restored.
  - b. Fail Secure: Gate cycles on battery power, then fail safe when battery is discharged.
3. External electric-powered [solenoid] [magnetic] lock with delay timer allowing time for lock to release before gate operates.
4. [Fire] [Postal] box.
5. Fire [strobe] [siren] alarm.
6. Intercom System: <Insert requirements>.
7. Instructional, Safety, and Warning Labels and Signs: [According to UL 325] [Manufacturer's standard for components and features specified] [As indicated on Drawings] <Insert requirements>.
8. Equipment Bases/Pads: Cast-in-place or precast concrete, [depth not less than 12 inches (300 mm)] <Insert depth 6 to 12 inches (150 to 300 mm) below frost line or detail on Drawings>, dimensioned and reinforced according to gate-operator component manufacturer's written instructions and as indicated on Drawings.

## 2.12 GROUT AND ANCHORING CEMENT

- A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.
- B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

## 2.13 GROUNDING MATERIALS

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connectors and Grounding Rods: Listed and labeled for complying with UL 467.

1. Connectors for Below-Grade Use: Exothermic welded type.
2. Grounding Rods: Copper-clad steel, 5/8 by 96 inches (16 by 2440 mm).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for[ **a certified survey of property lines and legal boundaries,**] site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
  1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of **500 feet (152 m)** or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

#### 3.3 CHAIN-LINK FENCE INSTALLATION

- A. Install chain-link fencing according to ASTM F 567 and more stringent requirements specified.
  1. Install fencing on established boundary lines inside property line.
- B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.
- C. Post Setting: Set posts [**in concrete**] [**with mechanical anchors**] [**by mechanically driving into soil**] at indicated spacing into firm, undisturbed soil.
  1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
  2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter.
    - a. Exposed Concrete: Extend **2 inches (50 mm)** above grade; shape and smooth to shed water.
    - b. Concealed Concrete: Place top of concrete [**2 inches (50 mm)**] **<Insert dimension>** below grade [**as indicated on Drawings**] to allow covering with surface material.
    - c. Posts Set into Sleeves in Concrete: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with [**nonshrink, nonmetallic grout**] [**or**] [**anchoring**]

- cement**], mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
- d. Posts Set into Holes in Concrete: Form or core drill holes not less than **5 inches (127 mm)** deep and **3/4 inch (20 mm)** larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink, nonmetallic grout] [or] [anchoring cement]**, mixed and placed according to anchoring material manufacturer's written instructions. Finish anchorage joint to slope away from post to drain water.
3. Mechanically Driven Posts: Drive into soil to depth of **[30 inches (762 mm)] [36 inches (914 mm)]** <Insert dimension>. Protect post top to prevent distortion.
- D. Terminal Posts: Install terminal end, corner, and gate posts according to ASTM F 567 and terminal pull posts at changes in horizontal or vertical alignment of **[15 degrees or more] [30 degrees or more] [as indicated on Drawings]** <Insert requirement>. For runs exceeding **500 feet (152 m)**, space pull posts an equal distance between corner or end posts.
  - E. Line Posts: Space line posts uniformly at **[96 inches (2440 mm)] [10 feet (3 m)]** <Insert dimension> o.c.
  - F. Post Bracing and Intermediate Rails: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
    1. Locate horizontal braces at midheight of fabric **72 inches (1830 mm)** or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.
  - G. Tension Wire: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with **0.120-inch- (3.05-mm-)** diameter hog rings of same material and finish as fabric wire, spaced a maximum of **24 inches (610 mm)** o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
    1. Extended along **[top] [and] [bottom]** of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within **6 inches (152 mm)** of bottom of fabric and tie to each post with not less than same diameter and type of wire.
    2. Extended along top of **[barbed wire arms] [extended posts]** and top of fence fabric to support barbed tape.
    3. **[As indicated on Drawings]** <Insert requirements>.
  - H. Top Rail: Install according to ASTM F 567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.
  - I. Intermediate and Bottom Rails: Secure to posts with fittings.
  - J. Chain-Link Fabric: Apply fabric to **[outside] [inside]** of enclosing framework. Leave **[1-inch (25-mm)] [2-inch (50-mm)]** bottom clearance between finish grade or surface and bottom

selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

- K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than **15 inches (380 mm)** o.c.
- L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric according to ASTM F 626. Bend ends of wire to minimize hazard to individuals and clothing.
  - 1. Maximum Spacing: Tie fabric to line posts at **12 inches (300 mm)** o.c. and to braces at **24 inches (610 mm)** o.c.
- M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side. [**Peen ends of bolts or score threads to prevent removal of nuts.**]
- N. Privacy Slats: Install slats in direction indicated, securely locked in place.
  - 1. [**Vertically**] [**Horizontally**][, for privacy factor of **70 to 75**] <Insert privacy factor range>.
  - 2. Diagonally[ for privacy factor of **80 to 85**] <Insert privacy factor range>.
  - 3. Direction[ **and privacy factor**] as indicated on Drawings.
- O. Barbed Wire: Install barbed wire uniformly spaced[, **angled toward security side of fence**] [**as indicated on Drawings**]. Pull wire taut, install securely to extension arms, and secure to end post or terminal arms.
- P. Barbed Tape: Install according to ASTM F 1911. Install barbed tape uniformly in configurations indicated and fasten securely to prevent movement or displacement.

### 3.4 GATE INSTALLATION

- A. Install gates according to manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

### 3.5 GATE-OPERATOR INSTALLATION

- A. Install gate operators according to manufacturer's written instructions, aligned and true to fence line and grade.
- B. Excavation: Hand-excavate holes for posts, pedestals, and equipment bases/pads, in firm, undisturbed soil to dimensions and depths and at locations according to gate-operator component manufacturer's written instructions and as indicated.
- C. Vehicle Loop Detector System: [**Cut grooves in pavement, bury, and seal**] [**Bury**] wire loop according to manufacturer's written instructions. Connect to equipment operated by detector.

- D. Ground electric-powered motors, controls, and other devices according to NFPA 70 and manufacturer's written instructions.

### 3.6 GROUNDING AND BONDING

- A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Fence and Gate Grounding:
  - 1. Ground for fence and fence posts shall be a separate system from ground for gate and gate posts.
  - 2. Install ground rods and connections at maximum intervals of [1500 feet (450 m)] <Insert dimension>.
  - 3. Fences within 100 Feet (30 m) of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [750 feet (225 m)] <Insert dimension>.
  - 4. Ground fence on each side of gates and other fence openings.
    - a. Bond metal gates to gate posts.
    - b. Bond across openings, with and without gates, except openings indicated as intentional fence discontinuities. Use No. 2 AWG wire and bury it at least 18 inches (457 mm) below finished grade.
- C. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at a ground rod located a maximum distance of 150 feet (45 m) on each side of crossing.
- D. Fences Enclosing Electrical Power Distribution Equipment: Ground according to IEEE C2 unless otherwise indicated.
- E. Grounding Method: At each grounding location, drive a grounding rod vertically until the top is 6 inches (152 mm) below finished grade. Connect rod to fence with No. 6 AWG conductor. Connect conductor to each fence component at grounding location.
  - 1. Make grounding connections to each barbed wire strand with wire-to-wire connectors designed for this purpose.
  - 2. Make grounding connections to each barbed tape coil with connectors designed for this purpose.
- F. Connections:
  - 1. Make connections with clean, bare metal at points of contact.
  - 2. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
  - 3. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
  - 4. Make above-grade ground connections with mechanical fasteners.
  - 5. Make below-grade ground connections with exothermic welds.
  - 6. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

- G. Bonding to Lightning Protection System: Ground fence and bond fence grounding conductor to lightning protection down conductor or lightning protection grounding conductor according to NFPA 780.
- H. Comply with requirements in Section 264113 "Lightning Protection for Structures."

### 3.7 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests.
- B. Grounding Tests: Comply with requirements in Section 264113 "Lightning Protection for Structures."
- C. Prepare test reports.

### 3.8 ADJUSTING

- A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Automatic Gate Operator: Energize circuits to electrical equipment and devices, start units, and verify proper motor rotation and unit operation.
  - 1. Hydraulic Operator: Purge operating system, adjust pressure and fluid levels, and check for leaks.
  - 2. Test and adjust operators, controls[, **alarms**,] and safety devices. Replace damaged and malfunctioning controls and equipment.
  - 3. Lubricate operator and related components.
- C. Lubricate hardware and other moving parts.

### 3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION 323113

## SECTION 323300 - SITE FURNISHINGS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

1. Seating.
2. Tables.
3. Bicycle racks.
4. Bicycle lockers.
5. Trash receptacles.
6. Ash receptacles.
7. Planters.
8. Bollards.

- B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for **[installing pipe sleeves cast] [installing anchor bolts cast] [formed voids]** in concrete footings.
2. Section 312000 "Earth Moving" for excavation for installing concrete footings.

## 1.3 ACTION SUBMITTALS

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

- B. Sustainable Design Submittals:

1. [<Double click to insert sustainable design text for recycled content.>](#)
2. [<Double click to insert sustainable design text for certified wood.>](#)

- C. Samples: For each exposed product and for each color and texture specified.

- D. Samples for Initial Selection: For units with factory-applied finishes.
- E. Samples for Verification: For each type of exposed finish, not less than **6-inch- (152-mm-)** long linear components and **4-inch- (102-mm-)** square sheet components.
  - 1. Include full-size Samples of [**bench**] [**table**] [**bicycle rack**] [**trash receptacle**] [**ash receptacle**] <Insert product>. Approved samples may be incorporated into the Work.
- F. Product Schedule: For site furnishings.[ **Use same designations indicated on Drawings**].

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For site furnishings manufactured with preservative-treated wood.
  - 1. 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.**]

#### 1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Bench Replacement [**Slats**] [**Planks**]: No fewer than [**two**] <Insert number> full-size units for each size indicated.
  - 2. Trash Receptacle Inner Containers: [**Five**] <Insert number> full-size units for each size indicated, but no fewer than [**two**] <Insert number> units.
  - 3. Anchors: <Insert type and number>.

### PART 2 - PRODUCTS

#### 2.1 SEATING <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Frame: [**Cast aluminum**] [**Cast iron**] [**Steel**] [**Stainless steel**] [**Wrought iron**] [**Cedar**] [**Teak**] <Insert material>.
- C. Seat[ **and Back**]:
  - 1. Material:
    - a. Aluminum Sheet: [**Perforated**] [**Expanded**] metal.



- b. **[Painted]** Steel: **[Perforated metal]** **[Expanded metal]** **[Evenly spaced, parallel flat straps or bars]** **[Evenly woven, flat straps or bars]** **[Edge framed, evenly spaced, parallel rods or rolled bars]** **<Insert description>**.
  - c. Stainless Steel: **[Perforated metal]** **[Expanded metal]** **[Evenly spaced, parallel flat straps or bars]** **[Evenly woven, flat straps or bars]** **[Edge framed, evenly spaced, parallel rods or rolled bars]** **<Insert description>**.
  - d. Wood: **[Douglas fir]** **[Pine]** **[Cedar]** **[Redwood]** **[Teak]** **<Insert species>**; formed into **[evenly spaced parallel slats]** **[planks]** **<Insert description>**.
  - e. **[Recycled]** **[Plastic]** **[Fiberglass]** Planks: **[Evenly spaced, parallel]** **<Insert description>**.
  - f. **[Recycled]** **[Plastic]** **[Fiberglass]** Sheet: **[Solid]** **[Perforated]**.
2. Seat Height: **[As indicated]** **<Insert dimension>**.
  3. Seat Surface Shape: **[Flat]** **[Contoured or dished]**.
  4. Overall Height: **[As indicated]** **<Insert dimension>**.
  5. Overall Width: **[As indicated]** **<Insert dimension>**.
  6. Overall Depth: **[As indicated]** **<Insert dimension>**.
  7. Arms: **[None]** **[One, as indicated]** **[Two, one at each end]** **[Three, one at each end and in center]** **<Insert requirements>**.
    - a. Arm Material: Match **[frame]** **[seat]** **<Insert component>**.
  8. Weight: **<Insert weight>**.
  9. Seating Configuration: Multiple units **[as indicated]**.
    - a. **[Straight]** **[Angled]** **[Curved]** shape.
    - b. Closed **[hexagon]** **[circle]** **[shape indicated]** around a **[tree trunk]** **[planter]** **[light post]** **<Insert central element>**.
- D. Aluminum Finish: **[Mill finish]** **[Color coated]**.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** **<Insert color>**.
- E. Steel Finish: **[Galvanized and]** **[color]** **[PVC-color]** coated.
1. Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** **<Insert color>**.
- F. Stainless-Steel Finish: **[No. 6]** **<Insert description>**.
- G. Wood Finish: **[Unfinished]** **[Factory-applied transparent finish]** **[Factory-applied stain and transparent finish]** **[Factory-applied opaque finish]** **[Manufacturer's standard finish]**.
1. Stain: **[Manufacturer's standard]** **<Insert stain type and color>**.
- H. **[Fiberglass]** **[HDPE]** Color: **[As indicated by manufacturer's designation]** **[Match Architect's samples]** **[As selected by Architect from manufacturer's full range]** **[As indicated in a site furnishing schedule]** **<Insert description>**.

- I. Graphics: [**Surface-applied**] [**Engraved**] [**Attached brass plaque with engraved**] copy, content, and style [**according to manufacturer's standard**] [**as indicated on Drawings**].

2.2 TABLES <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Frame: [**Cast aluminum**] [**Cast iron**] [**Steel**] [**Stainless steel**] [**Wrought iron**] [**Cedar**] [**Teak**] <Insert material>.
- C. Table Top:
1. Material:
    - a. Aluminum Sheet: [**Perforated**] [**Expanded**] metal.
    - b. [**Painted**] Steel: [**Perforated metal**] [**Expanded metal**] [**Evenly spaced, parallel flat straps or bars**] [**Evenly woven, flat straps or bars**] [**Edge framed, evenly spaced, parallel rods or rolled bars**] <Insert description>.
    - c. Stainless Steel: [**Perforated metal**] [**Expanded metal**] [**Evenly spaced, parallel flat straps or bars**] [**Evenly woven, flat straps or bars**] [**Edge framed, evenly spaced, parallel rods or rolled bars**] <Insert description>.
    - d. Wood: [**Douglas fir**] [**Pine**] [**Cedar**] [**Redwood**] [**Teak**] <Insert species>; formed into [**evenly spaced parallel slats**] [**planks**] <Insert description>.
    - e. [**Recycled**] [**Plastic**] [**Fiberglass**] Planks: [**Evenly spaced, parallel**] <Insert description>.
    - f. [**Recycled**] [**Plastic**] [**Fiberglass**] Sheet: [**Solid**] [**Perforated**].
  2. Surface Shape: [**Round**] [**Hexagon**] [**Shape indicated**] <Insert shape>.
  3. Feature: [**Center umbrella hole**] <Insert feature>.
- D. Aluminum Finish: [**Mill finish**] [**Color coated**].
1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert color>.
- E. Steel Finish: [**Galvanized and**] [**color**] [**PVC-color**] coated.
1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert color>.
- F. Stainless-Steel Finish: [**No. 6**] <Insert description>.
- G. Wood Finish: [**Unfinished**] [**Factory-applied transparent finish**] [**Factory-applied stain and transparent finish**] [**Factory-applied opaque finish**] [**Manufacturer's standard finish**].
1. Stain: [**Manufacturer's standard**] <Insert stain type and color>.

- H. **[Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
- I. Graphics: **[Surface-applied] [Engraved] [Attached brass plaque with engraved] copy, content, and style [per manufacturer's standard] [as indicated on Drawings].**

### 2.3 BICYCLE RACKS <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Bicycle Rack Construction:
  - 1. Frame: **[Aluminum] [Steel] [Galvanized steel] [Stainless steel] [Steel and redwood] [Steel and pine] <Insert description>.**
    - a. **[Pipe] [Tubing] OD: Not less than [1-5/8 inches (41 mm)] [2-3/8 inches (60 mm)] [2-7/8 inches (73 mm)] [4-1/2 inches (115 mm)] <Insert dimension>.**
    - b. Locking Bars: Solid round bar, not less than **[3/4 inch (19 mm)] [1 inch (25 mm)]** in diameter.
  - 2. Style: **[Single-side parking] [Double-side parking] [Bollard] [As indicated] <Insert description>.**
    - a. Overall Height: **[As indicated] <Insert dimension>.**
    - b. Overall Width: **[As indicated] <Insert dimension>.**
    - c. Overall Depth: **[As indicated] <Insert dimension>.**
    - d. Capacity: Designed to accommodate no fewer than **[two] [three] [four] <Insert number>** bicycles.
  - 3. Security: Designed to lock **[wheel] [and] [frame].**
  - 4. Accessories: **[Base covers for each pipe and tubing anchored end] [Wheel stops] <Insert accessory>.**
  - 5. Installation Method: **[Freestanding] [Surface flange anchored at finished grade to substrate indicated] [Surface flange anchored below finished grade to substrate indicated] [Cast in concrete] [Bolted to cast-in anchor bolts] [Wall mounted] [As indicated].**
- C. Aluminum Finish: **[Mill finish] [Color coated].**
  - 1. Color: **[As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.**
- D. Steel Finish: **[Galvanized] [Color coated].**
  - 1. Color: **[As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert color>.**

- E. Stainless-Steel Finish: [No. 4] <Insert description>.
- F. Wood Finish: [Unfinished] [Manufacturer's standard finish].

#### 2.4 BICYCLE LOCKERS <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Bicycle Locker Construction:
  1. Locker: [Molded one-piece fiberglass] [Steel sheet, **0.053 inch (1.4 mm)** thick] [Steel sheet, **0.053 inch (1.4 mm)** thick, with perforated metal sides] [with welded tubular steel frame] <Insert material>.
  2. Door: [Molded one-piece fiberglass] [Steel sheet, **0.053 inch (1.4 mm)** thick] [with tubular steel frame] [Match locker] <Insert material>.
  3. View [Window] [Grille]: [Lexan, **12 inches (305 mm)** square] [Perforated metal].
  4. Lock: [Manufacturer's standard] [Key lock with internal locking bar] [Coin/token lock] <Insert description>.
    - a. Provide [four] <Insert number> keys.
  5. Overall Height: [As indicated] <Insert dimension>.
  6. Overall Width: [As indicated] <Insert dimension>.
  7. Overall Depth: [As indicated] <Insert dimension>.
  8. Capacity: Designed to accommodate [one] [two] bicycle(s).
  9. Installation Method: [Locker anchored at finished grade to substrate indicated] [Locker anchored below finished grade to substrate indicated] [As indicated].
  10. Locker Configuration: [Multiple] [Four] <Insert number> units[ as indicated], in [straight row] [curved shape] [shape indicated] <Insert description>.
- C. Steel Finish: Color coated.
  1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- D. Fiberglass Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.

#### 2.5 TRASH RECEPTACLES <Insert drawing designation>

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Aluminum Facing Surrounds: [Aluminum sheet] [Perforated aluminum sheet] [Grid in tubular frame] [Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes] [Match benches] <Insert material and description>.
- C. Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or

**tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.**

- D. Stainless-Steel Facing Surrounds: **[Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.**
- E. Wood Facing Surrounds: **[Evenly spaced, Douglas fir slats] [Evenly spaced pine slats] [Evenly spaced cedar slats] [Redwood panels] [Evenly spaced redwood slats] [Teak panels] [Evenly spaced teak slats] [Match benches] <Insert wood type and description>.**
- F. Fiberglass Facing Surrounds: Molded fiberglass shape.
- G. Plastic Facing Surrounds: **[Molded HDPE shape] [Evenly spaced HDPE slats] [Evenly spaced, recycled HDPE slats] [Match benches] <Insert plastic type and description>.**
- H. Support Frames: **[Steel] [Galvanized steel];** welded.
- I. Trash Receptacles:
1. Receptacle Shape and Form: **[Round cylinder] [Round cylinder with tapered funnel top] [Round, tapered column] [Square column] [Rectangular column] [As indicated] <Insert shape and form>**; with opening for depositing trash in **[lid or top] [side of lid or top] [receptacle side]**.
  2. Lids and Tops: **[Matching facing panels] [Aluminum] [Steel] [HDPE] [Recycled HDPE] <Insert material and description>** secured by cable or chain, hinged, swiveled, or permanently secured.
    - a. Description: **[Flat rim ring lid with center opening] [Dome top] [Arched top] [Elevated flat or shallow dome rain-cap lid] [Combination ash sand pan and rim lid] [Combination ash sand pan and dome top] [Combination ash sand pan and elevated flat or shallow dome rain-cap lid] <Insert description>.**
    - b. Opening for depositing trash covered by **[self-closing, spring-loaded-hinged, push-in] [rotating]** weather flap.
  3. Receptacle Height: **[As indicated] <Insert dimension>.**
  4. Overall Width: **[As indicated] <Insert dimension>.**
  5. Weight: **<Insert weight>.**
  6. Inner Container: **[Aluminum] [Galvanized-steel sheet] [Perforated-metal] [Fiberglass] [Rigid plastic]** container with **[drain holes] [lift-out handles]**; designed to be removable and reusable.
  7. Disposable Liners: Provide receptacle designed to accommodate disposable liners.
  8. Capacity: Not less than **[22 gal. (83 L)] [28 gal. (106 L)] [30 gal. (114 L)] [32 gal. (121 L)] [40 gal. (151 L)] [55 gal. (208 L)] <Insert value>.**
  9. Service Access: **[Removable lid or top] [Fixed lid or top, side access]**; inner container and disposable liner lift or slide-out for emptying**;** **[lockable with padlock hasps] [keyed lock with two keys per receptacle] [self-latching hinge]**.
  10. Post Mount: **[Color-coated steel pipe; color to match receptacle] [Galvanized-steel pipe] [Wood]**; for mounting **[one] [two] [three]** receptacle(s).

- J. Aluminum Finish: [**Mill finish**] [**Color coated**].
    - 1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
  - K. Steel Finish: [**Galvanized and**] [**color**] [**PVC-color**] coated.
    - 1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
  - L. Stainless-Steel Finish: [**No. 6**] <Insert description>.
  - M. Wood Finish: [**Unfinished**] [**Factory-applied transparent finish**] [**Factory-applied stain and transparent finish**] [**Factory-applied opaque finish**] [**Manufacturer's standard finish**].
    - 1. Stain: [**Manufacturer's standard**] <Insert stain type and color>.
  - N. [**Fiberglass**] [**HDPE**] Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
  - O. Graphics: [**Surface-applied**] [**Engraved**] [**Attached brass plaque with engraved**] copy, content, and style [**according to manufacturer's standard**] [**as indicated on Drawings**].
    - 1. Copy: [**Litter**] [**Trash**] [**Waste**] [**Recycle**] <Insert term>.
- 2.6 ASH RECEPTACLES <Insert drawing designation>
- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  - B. Aluminum Facing Surrounds: [**Aluminum sheet**] [**Perforated aluminum sheet**] [**Grid in tubular frame**] [**Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes**] [**Match benches**] <Insert material and description>.
  - C. Steel Facing Surrounds: [**Steel sheet**] [**Perforated-steel sheet**] [**Evenly patterned, parallel flat steel straps, bars, or tubular shapes**] [**Evenly patterned, parallel round steel rods, bars, or tubular shapes**] [**Grid in tubular frame**] [**Match benches**] <Insert material and description>.
  - D. Stainless-Steel Facing Surrounds: [**Steel sheet**] [**Perforated-steel sheet**] [**Evenly patterned, parallel flat steel straps, bars, or tubular shapes**] [**Evenly patterned, parallel round steel rods, bars, or tubular shapes**] [**Grid in tubular frame**] [**Match benches**] <Insert material and description>.
  - E. Fiberglass Facing Surrounds: Molded fiberglass shape.
  - F. Support Frames: [**Steel**] [**Galvanized steel**]; welded.
  - G. Ash Receptacles:

1. Receptacle Shape and Form: [**Round cylinder**] [**Round cylinder with tapered funnel top**] [**Round, tapered column**] [**Square column**] [**Rectangular column**] [**As indicated**] <Insert shape and form>; with opening for depositing trash in [**lid or top**] [**side of lid or top**] [**receptacle side**].
  2. Function: [**Uncovered receptacle with sand pan**] [**Uncovered receptacle with bowl and funnel**] [**Covered receptacle with sand pan**] [**Covered receptacle with bowl and screen**] [**Covered receptacle with slots**] [**Uncovered receptacle with sand pan attaching to side of trash receptacle**] <Insert description and accessories> for depositing cigarette butts; fire-proof design; bowl and pan removable for cleaning.
  3. Lids and Tops: [**Matching facing panels**] [**Aluminum**] [**Steel**] [**HDPE**] [**Recycled HDPE**] <Insert material and description> secured by cable or chain, hinged, swiveled, or permanently secured.
    - a. Description: [**Flat rim ring lid with center opening**] [**Dome top**] [**Arched top**] [**Elevated flat or shallow dome rain-cap lid**] [**Combination ash sand pan and rim lid**] [**Combination ash sand pan and dome top**] [**Combination ash sand pan and elevated flat or shallow dome rain-cap lid**] <Insert description>.
  4. Receptacle Height: [**As indicated**] <Insert dimension>.
  5. Overall Width: [**As indicated**] <Insert dimension>.
  6. Weight: <Insert weight>.
  7. Post Mount: [**Color-coated steel pipe; color to match receptacle**] [**Galvanized-steel pipe**] [**Wood**]; for mounting [**one**] [**two**] [**three**] receptacle(s).
  8. Accessories: [**Sand sifter**] [**Butt stub-out**] <Insert accessory>.
- H. Aluminum Finish: [**Mill finish**] [**Color coated**].
1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
- I. Steel Finish: [**Galvanized and**] [**color**] [**PVC-color**] coated.
1. Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
- J. Stainless-Steel Finish: [**No. 6**] <Insert description>.
- K. [**Fiberglass**] [**HDPE**] Color: [**As indicated by manufacturer's designation**] [**Match Architect's samples**] [**As selected by Architect from manufacturer's full range**] [**As indicated in a site furnishing schedule**] <Insert description>.
- 2.7 PLANTERS <Insert drawing designation>
- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  - B. Aluminum Facing Surrounds: [**Aluminum sheet**] [**Perforated aluminum sheet**] [**Grid in tubular frame**] [**Evenly patterned, parallel flat aluminum straps, bars, or tubular shapes**] [**Match benches**] <Insert material and description>.

- C. Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.
- D. Stainless-Steel Facing Surrounds: [Steel sheet] [Perforated-steel sheet] [Evenly patterned, parallel flat steel straps, bars, or tubular shapes] [Evenly patterned, parallel round steel rods, bars, or tubular shapes] [Grid in tubular frame] [Match benches] <Insert material and description>.
- E. Wood Facing Surrounds: [Evenly spaced, Douglas fir slats] [Evenly spaced pine slats] [Evenly spaced cedar slats] [Redwood panels] [Evenly spaced redwood slats] [Teak panels] [Evenly spaced teak slats] [Match benches] <Insert wood type and description>.
- F. Fiberglass Facing Surrounds: Molded fiberglass shape.
- G. Plastic Facing Surrounds: [Molded HDPE shape] [Evenly spaced HDPE slats] [Evenly spaced, recycled HDPE slats] [Match benches] <Insert plastic type and description>.
- H. Support Frames: [Steel] [Galvanized steel]; welded.
- I. Planter Shape and Form: [Round cylinder] [Round cylinder with tapered funnel top] [Round, tapered column] [Square column] [Rectangular column] [As indicated] <Insert shape and form>.
- J. Style: [To match benches] [As indicated by manufacturer's designation].
- K. Overall Height: [As indicated] <Insert dimension>.
- L. Overall [Diameter] [Width]: [As indicated] <Insert dimension>.
- M. Overall Depth: [As indicated] <Insert dimension>.
- N. Weight: <Insert weight>.
- O. Inner Container: [Aluminum] [Galvanized-steel sheet] [Fiberglass] [Rigid plastic] container[ with drain holes].
- P. Capacity: Not less than [22 gal. (83 L)] [28 gal. (106 L)] [30 gal. (114 L)] [32 gal. (121 L)] [40 gal. (151 L)] [55 gal. (208 L)] <Insert value>.
- Q. Installation Method: [Freestanding] [Freestanding with weighted base] [Anchored to substrate indicated on Drawings] [Wall mounted] [Post mounted] [Mounted on elevated leg angles anchored at finished grade to substrate indicated on Drawings] [Mounted on elevated leg angles anchored below finished grade to substrate indicated on Drawings] [As indicated on Drawings].
1. Post Mount: [Color-coated steel pipe; color to match receptacle] [Galvanized-steel pipe] [Wood]; for mounting [one] [two] [three] planter(s).
- R. Aluminum Finish: Color coated.



1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- S. Steel Finish: [Galvanized and] [color] [PVC-color] coated.
1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- T. Stainless-Steel Finish: [No. 6] <Insert description>.
- U. Wood Finish: [Unfinished] [Factory-applied transparent finish] [Factory-applied stained and transparent finish].
1. Stain: <Insert stain type and color>.
- V. [Fiberglass] [HDPE] Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
1. Finish: [Smooth] [Textured].
- 2.8 BOLLARDS <Insert drawing designation>
- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Bollard Construction:
1. [Pipe] [Tubing] [Cast Iron] OD: Not less than [4-1/2 inches (115 mm)] <Insert dimension>[, fluted].
    - a. Steel: [Schedule 40] [Schedule 80] pipe.
    - b. Aluminum: [Extruded pipe and tubes] [Castings].
    - c. Stainless Steel: [Tubes] [Pipe].
    - d. Cast Iron: [Tapered] [As indicated].
  2. [Round] [Square] Wood: [Cedar] <Insert material>, [8 inches (203 mm) square] [10 inches (254 mm) in diameter].
  3. Style: [Manufacturer's standard] [Chamfered top] [Dome top] [Ornamental cap] [As indicated] <Insert description>.
  4. Overall Height: [As indicated] <Insert dimension>.
  5. Overall Width: [As indicated] <Insert dimension>.
  6. Overall Depth: [As indicated] <Insert dimension>.
  7. Accessories: [Eye bolts] <Insert accessory>.
  8. Installation Method: [Surface flange anchored at finished grade to substrate indicated] [Surface flange anchored below finished grade to substrate indicated] [Cast in concrete] [Bolted to cast-in anchor bolts] [As indicated].
- C. Aluminum Finish: [Mill finish] [Color coated].

1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- D. Steel Finish: [Galvanized] [Color coated].
1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- E. Cast-Iron Finish: [Manufacturer's standard] [Galvanized] [Color coated].
1. Color: [As indicated by manufacturer's designation] [Match Architect's samples] [As selected by Architect from manufacturer's full range] [As indicated in a site furnishing schedule] <Insert description>.
- F. Stainless-Steel Finish: [No. 4] <Insert description>.
- G. Wood Finish: [Unfinished] [Manufacturer's standard finish].

## 2.9 MATERIALS

- A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated; free of surface blemishes and complying with the following:
1. Rolled or Cold-Finished Bars, Rods, and Wire: **ASTM B 211 (ASTM B 211M)**.
  2. Extruded Bars, Rods, Wire, Profiles, and Tubes: **ASTM B 221 (ASTM B 221M)**.
  3. Structural Pipe and Tube: ASTM B 429/B 429M.
  4. Sheet and Plate: **ASTM B 209 (ASTM B 209M)**.
  5. Castings: ASTM B 26/B 26M.
- B. Steel and Iron: Free of surface blemishes and complying with the following:
1. Plates, Shapes, and Bars: ASTM A 36/A 36M.
  2. Steel Pipe: Standard-weight steel pipe complying with ASTM A 53/A 53M, or electric-resistance-welded pipe complying with ASTM A 135/A 135M.
  3. Tubing: Cold-formed steel tubing complying with ASTM A 500/A 500M.
  4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A 513/A 513M, or steel tubing fabricated from steel complying with ASTM A 1011/A 1011M and complying with dimensional tolerances in ASTM A 500/A 500M; zinc coated internally and externally.
  5. Sheet: Commercial steel sheet complying with ASTM A 1011/A 1011M.
  6. Perforated Metal: From steel sheet not less than [**0.075-inch (1.9-mm)**] [**0.090-inch (2.3-mm)**] [**0.120-inch (3.0-mm)**] <Insert dimension> nominal thickness; manufacturer's standard perforation pattern.
  7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F 1267.
  8. Malleable-Iron Castings: ASTM A 47/A 47M, grade as recommended by fabricator for type of use intended.
  9. Gray-Iron Castings: ASTM A 48/A 48M, Class 200.

- C. Stainless Steel: Free of surface blemishes and complying with the following:
1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
  2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
  3. Tubing: ASTM A 554.
- D. Wood: Surfaced smooth on four sides with eased edges; kiln dried, free of knots, solid stock of species indicated.
1. Wood Species:[ **Manufacturer's standard.**]
    - a. Douglas Fir: Clear Grade, vertical grain.
    - b. Pine: Southern pine; No. 2 or better[; **preservative treated, kiln dried after treatment**].
    - c. [**Eastern White**] [**Red**] [**Yellow**] Cedar: Select Grade or better.
    - d. Redwood: [**Clear all heart**] [**Construction heart or better**], free-of-heart center.
    - e. Teak (Tectona Grandis): Clear Grade.
    - f. **<Insert wood species>**: **<Insert grade, if applicable, and other requirements>**.
- E. [<Double click to insert sustainable design text for certified wood.>](#)
1. Finish: Manufacturer's standard [**stain**] [**and**] [**transparent sealer**] [**transparent wood-preservative treatment and sealer**] **<Insert treatment or finish>**.
- F. Fiberglass: Multiple laminations of glass-fiber-reinforced polyester resin with UV-light stable, colorfast, nonfading, weather- and stain-resistant, colored polyester gel coat, and with manufacturer's standard finish.
- G. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
1. Polyethylene: Fabricated from virgin plastic HDPE resin.
  2. [<Double click to insert sustainable design text for recycled polyethylene>](#)
- H. Anchors, Fasteners, Fittings, and Hardware: [**Stainless steel**] [**Brass**] [**Galvanized steel**] [**Zinc-plated steel**] [**Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials**]; commercial quality[, **tamperproof, vandal and theft resistant**] [, **concealed, recessed, and capped or plugged**].
1. Angle Anchors: For inconspicuously bolting legs of site furnishings to [**on**] [**below**]-grade substrate; [**one per leg**] [**extent as indicated**] **<Insert extent>**.
  2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; [**two per unit**] [**extent as indicated on Drawings**] **<Insert extent>**.
- I. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M; recommended in writing by manufacturer, for exterior applications.
- J. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure

without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

- K. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of **0.9 oz./sq. ft. (0.27 kg/sq. m)** of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than **0.3 mil (0.0076 mm)** thick.
  2. Hot-Dip Galvanizing: According to ASTM A 123/A 123M, ASTM A 153/A 153M, or ASTM A 924/A 924M.

## 2.10 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment: Pressure-treat wood according to AWPA U1, Use Category UC3b, and the following:
1. Use preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium. Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants to distinguish treated materials from untreated materials.
  2. Kiln-dry lumber and plywood after treatment to a maximum moisture content, respectively, of 19 and 15 percent. Do not use materials that are warped or do not comply with requirements for untreated materials.

## 2.11 FABRICATION

- A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.
- B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.
- C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.
- D. Preservative-Treated Wood Components: Complete fabrication of treated items before treatment if possible. If cut after treatment, apply field treatment complying with AWPA M4 to cut surfaces.
- E. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

- F. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

## 2.12 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.13 ALUMINUM FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## 2.14 STEEL AND GALVANIZED-STEEL FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.
- B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

## 2.15 IRON FINISHES

- A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

## 2.16 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run directional finishes with long dimension of each piece.
  - 2. Directional Satin Finish: No 4.
  - 3. Dull Satin Finish: No. 6.

## PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 3.2 INSTALLATION

- A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.
- B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.
- C. Install site furnishings level, plumb, true, and **[securely anchored]** **[positioned]** at locations indicated on Drawings.
- D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.
- E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and **3/4 inch (19 mm)** larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with **[nonshrink, nonmetallic grout]** **[or]** **[anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.
- F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with **[nonshrink, nonmetallic grout]** **[or]** **[anchoring cement]**, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

END OF SECTION 323300

## SECTION 328400 - PLANTING IRRIGATION

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Piping.
2. Encasement for piping.
3. Manual valves.
4. Pressure-reducing valves.
5. Automatic control valves.
6. Automatic drain valves.
7. Transition fittings.
8. Dielectric fittings.
9. Miscellaneous piping specialties.
10. Sprinklers.
11. Quick couplers.
12. Drip irrigation specialties.
13. Controllers.
14. Boxes for automatic control valves.

## B. Related Sections:

1. Section 220519 "Meters and Gages for Plumbing Piping" for water metering requirements.
2. Section 230923.14 "Flow Instruments" for water metering equipment.

## 1.3 DEFINITIONS

- A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

- B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.
- C. ET Controllers: EvapoTranspiration Controllers. Irrigation controllers which use some method of weather based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET; broadcasting of ET measurements; or use of on-site sensors to track ET.
- D. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Irrigation zone control shall be [**automatic operation with controller and automatic control**] [**manual operation with manual**] valves.
- B. Location of Sprinklers and Specialties: Design location is approximate. Make minor adjustments necessary to avoid plantings and obstructions such as signs and light standards. Maintain 100 percent irrigation coverage of areas indicated.
- C. Delegated Design: Design 100 percent coverage irrigation system, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 1. Available land records indicate the following soil conditions:
    - a. Type: [**Coarse**] [**Medium**] [**Fine**] <Insert type>.
    - b. Texture:
      - 1) Sand: <Insert number> percent.
      - 2) Silt: <Insert number> percent.
      - 3) Clay: <Insert number> percent.
    - c. Particle Size:
      - 1) Sand: <Insert number> mm.
      - 2) Silt: <Insert number> mm.
      - 3) Clay: <Insert number> mm.
    - d. Structure: [**Single grained**] [**Granular**] [**Platy**] [**Blocky**] <Insert structure>.
    - e. Density: <Insert **lb/cu. ft. (kg./cu. m)**>.
    - f. Moisture Content: <Insert number> percent.
    - g. Infiltration Rate: <Insert **gph (L/s)**>.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
  - 1. Irrigation Main Piping: [**200 psig (1380 kPa)**] <Insert value>.
  - 2. Circuit Piping: [**150 psig (1035 kPa)**] <Insert value>.



## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, **[electrical characteristics,]** and furnished specialties and accessories.
- B. Wiring Diagrams: For power, signal, and control wiring.
- C. Delegated-Design Submittal: For irrigation systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Sustainable Design Submittals:
  - 1. [<Double click to insert sustainable design text for irrigation control system.>](#)
  - 2. [<Double click to insert sustainable design text for submetering submittal.>](#)

## 1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are shown and coordinated with each other, using input from Installers of the items involved. Also include adjustments necessary to avoid plantings and obstructions such as signs and light standards.
- B. Qualification Data: For qualified Installer.
- C. Zoning Chart: Show each irrigation zone and its control valve.
- D. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.
- E. Field quality-control reports.

## 1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For **[sprinklers] [controllers] [and] [automatic control valves]** to include in operation and maintenance manuals.

## 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Impact Sprinklers: Equal to **<Insert number>** percent of amount installed for each type and size indicated, but no fewer than **<Insert number>** units.
  - 2. Spray Sprinklers: Equal to **<Insert number>** percent of amount installed for each type and size indicated, but no fewer than **<Insert number>** units.
  - 3. Bubblers: Equal to **<Insert number>** percent of amount installed for each type indicated, but no fewer than **<Insert number>** units.
  - 4. Emitters: Equal to **<Insert number>** percent of amount installed for each type indicated, but no fewer than **<Insert number>** units.

5. Drip-Tube System Tubing: Equal to **<Insert number>** percent of total length installed for each type and size indicated, but not less than **[100 feet (30 m)] [500 feet (152 m)] <Insert value>**.
6. Soaker Tubes: Equal to **<Insert number>** percent of total length installed for each type and size indicated, but not less than **[50 feet (15.2 m)] [100 feet (30 m)] <Insert value>**.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers that include a **[certified irrigation designer qualified by The Irrigation Association] [Professional Class member of the American Society of Irrigation Consultants] [Professional Technical Class member of the American Society of Irrigation Consultants] <Insert qualifications>**.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

## 1.11 PROJECT CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in the piping schedule for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.
- B. Galvanized-Steel Pipe: ASTM A 53/A 53M, Standard Weight, Type E, Grade B.
  1. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106/A 106M, Standard Weight, seamless-steel pipe with threaded ends.
  2. Galvanized, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

3. Malleable-Iron Unions: ASME B16.39, Class 150, hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface, and female threaded ends.
  4. Cast-Iron Flanges: ASME B16.1, Class 125.
- C. Ductile-Iron Pipe with Mechanical Joints: AWWA C151, with mechanical-joint bell and spigot ends.
1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.
- D. Ductile-Iron Pipe with Push-on Joint: AWWA C151, with push-on-joint bell and spigot ends.
1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
    - a. Gaskets: AWWA C111, rubber.
- E. Soft Copper Tube: **ASTM B 88, Type L (ASTM B 88M, Type B)**, water tube, annealed temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
  3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- F. Hard Copper Tube: [**ASTM B 88, Type L (ASTM B 88M, Type B)**,] [**and**] [**ASTM B 88, Type M (ASTM B 88M, Type C)**,] water tube, drawn temper.
1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
  3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. PE Pipe with Controlled ID: ASTM F 771, PE 3408 compound; [**SIDR 11.5**] [**and**] [**SIDR 15**].
1. Insert Fittings for PE Pipe: ASTM D 2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.
- H. PE Pipe with Controlled OD: ASTM F 771, PE 3408 compound, SDR 11.
1. PE Butt, Heat-Fusion Fittings: ASTM D 3261.
  2. PE Socket-Type Fittings: ASTM D 2683.
- I. PE Pressure Pipe: AWWA C906, with DR of 7.3, 9, or 9.3 and PE compound number required to give pressure rating not less than [**160 psig (1100 kPa)**] [**200 psig (1380 kPa)**].
1. PE Butt, Heat-Fusion Fittings: ASTM D 3261.
  2. PE Socket-Type Fittings: ASTM D 2683.

- J. PVC Pipe: ASTM D 1785, PVC 1120 compound, [**Schedule 40**] [**Schedule 80**] [**Schedules 40 and 80**].
  - 1. PVC Socket Fittings: ASTM D 2466, [**Schedule 40**] [**Schedule 80**] [**Schedules 40 and 80**].
  - 2. PVC Threaded Fittings: ASTM D 2464, Schedule 80.
  - 3. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
  
- K. PVC Pipe, Pressure Rated: ASTM D 2241, PVC 1120 compound, [**SDR 21**] [**and**] [**SDR 26**].
  - 1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
  - 2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

## 2.2 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, **1/8 inch (3.2 mm)** thick unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

## 2.3 ENCASUREMENT FOR PIPING

- A. Standard: ASTM A 674 or AWWA C105.
- B. Form: [**Sheet**] [**Sheet or tube**] [**Tube**].
- C. Material: [**LLDPE film of 0.008-inch (0.20-mm)**] [**LLDPE film of 0.008-inch (0.20-mm) minimum thickness or high-density, cross-laminated PE film of 0.004-inch (0.10-mm)**] [**High-density, cross-laminated PE film of 0.004-inch (0.10-mm)**] minimum thickness.
- D. Color: [**Black**] [**or**] [**Natural**] <Insert color>.

## 2.4 MANUAL VALVES

- A. Curb Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Standard: AWWA C800.
    - b. NPS 1 (DN 25) and Smaller Pressure Rating: [**100 psig (690 kPa) minimum**] [**150 psig (1035 kPa)**].
    - c. NPS 1-1/4 to NPS 2 (DN 32 to DN 50) Pressure Rating: [**80 psig (550 kPa) minimum**] [**150 psig (1035 kPa)**].
    - d. Body Material: Brass or bronze with ball or ground-key plug.
    - e. End Connections: Matching piping.
    - f. Stem: With wide-tee head.
- B. Curb-Valve Casing:
1. Standard: Similar to AWWA M44 for cast-iron valve casings.
  2. Top Section: Telescoping, of length required for depth of burial of curb valve.
  3. Barrel: Approximately **3-inch (75-mm)** diameter.
  4. Plug: With lettering "WATER."
  5. Bottom Section: With base of size to fit over valve.
  6. Base Support: Concrete collar[ **or wood frame**].
- C. Shutoff Rods for Curb-Valve Casings: Furnish [**one**] [**two**] **<Insert number>** steel, tee-handle shutoff rod(s) with one pointed end, stem of length to operate deepest buried valve, and slotted end matching curb valve for Project.
- D. Brass Ball Valves:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: **150 psig (1035 kPa)**.
    - c. CWP Rating: **600 psig (4140 kPa)**.
    - d. Body Design: Two piece.
    - e. Body Material: Forged brass.
    - f. Ends: Threaded or solder joint if indicated.
    - g. Seats: PTFE or TFE.
    - h. Stem: Brass.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full[ **or regular, but not reduced**].
- E. Bronze Ball Valves:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: **150 psig (1035 kPa)**.
    - c. CWP Rating: **600 psig (4140 kPa)**.
    - d. Body Design: Two piece.
    - e. Body Material: Bronze.

- f. Ends: Threaded or solder joint if indicated.
- g. Seats: PTFE or TFE.
- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Full[ **or regular, but not reduced**].

F. Iron Ball Valves:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description:
  - a. Standard: MSS SP-72.
  - b. CWP Rating: **200 psig (1380 kPa)**.
  - c. Body Design: Split body.
  - d. Body Material: ASTM A 126, gray iron.
  - e. Ends: Flanged.
  - f. Seats: PTFE or TFE.
  - g. Stem: Stainless steel.
  - h. Ball: Stainless steel.
  - i. Port: Full.

G. Plastic Ball Valves:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description:
  - a. Standard: MSS SP-122.
  - b. Pressure Rating: [**125 psig (860 kPa) minimum**] [**150 psig (1035 kPa)**].
  - c. Body Material: PVC.
  - d. Type: Union.
  - e. End Connections: Socket or threaded.
  - f. Port: Full.

H. Bronze Gate Valves:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description:
  - a. Standard: MSS SP-80, Type 2.
  - b. Class: 125.
  - c. CWP Rating: **200 psig (1380 kPa)**.
  - d. Body Material: ASTM B 62 bronze with integral seat and screw-in bonnet.
  - e. Ends: Threaded or solder joint.
  - f. Stem: Bronze, nonrising.
  - g. Disc: Solid wedge; bronze.
  - h. Packing: Asbestos free.
  - i. Handwheel: Malleable iron, bronze, or aluminum.

I. Iron Gate Valves, Resilient Seated:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Description:
  - a. Standard: AWWA C509.
  - b. Pressure Rating: [200 psig (1380 kPa)] [250 psig (1725 kPa)] minimum.
  - c. Body Material: Ductile or gray iron with bronze trim.
  - d. End Connections: Mechanical joint or push-on joint.
  - e. Interior Coating: Comply with AWWA C550.
  - f. Body Design: Nonrising stem.
  - g. Operator: Stem nut.
  - h. Disc: Solid wedge with resilient coating.
  
- J. Iron Gate Valve Casings:
  1. Standard: AWWA M44 for cast-iron valve casings.
  2. Top Section: Adjustable extension of length required for depth of burial of valve.
  3. Barrel: Approximately 5-inch (125-mm) diameter.
  4. Plug: With lettering "WATER."
  5. Bottom Section: With base of size to fit over valve.
  6. Base Support: Concrete collar[ or wood frame].
  
- K. Operating Wrenches for Iron Gate Valve Casings: Furnish [one] [two] <Insert number> steel, tee-handle operating wrench(es) with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut for Project.
  
- L. Iron Gate Valves, NRS:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Standard: MSS SP-70, Type I.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - d. Ends: Flanged.
    - e. Trim: All bronze.
    - f. Disc: Solid wedge.
    - g. Packing and Gasket: Asbestos free.
  
- M. Iron Gate Valves, OS&Y:
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Standard: MSS SP-70, Type I.
    - b. CWP Rating: 200 psig (1380 kPa).
    - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
    - d. Ends: Flanged.
    - e. Trim: All bronze.
    - f. Disc: Solid wedge.
    - g. Packing and Gasket: Asbestos free.

## 2.5 PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description:
  - a. Standard: ASSE 1003.
  - b. Body Material: Bronze for **NPS 2 (DN 50)** and smaller; cast iron[ **with interior lining complying with AWWA C550 or that is FDA approved**] for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.
  - c. Pressure Rating: Initial pressure of **150 psig (1035 kPa)**.
  - d. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; flanged for **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**.
3. Capacities and Characteristics:
  - a. Size: **<Insert NPS (DN)>**.
  - b. Design Flow Rate: **<Insert gpm (L/s)>**.
  - c. Design Inlet Pressure: **<Insert psig (kPa)>**.
  - d. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.

### B. Water Control Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Pilot-operation, diaphragm-type, single-seated main water control valve. Include small pilot control valve, restrictor device, specialty fittings, and sensor piping.
  - a. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
  - b. Pattern: [**Angle**] [**Globe**]-valve design.
  - c. Trim: Stainless steel.
  - d. Pressure Rating: Initial pressure of **150 psig (1035 kPa)** minimum.
  - e. End Connections: Threaded for **NPS 2 (DN 50)** and smaller; [**flanged**] **<Insert type>** for **NPS 2-1/2 (DN 65)** and larger.
3. Capacities and Characteristics:
  - a. Size: **<Insert NPS (DN)>**.
  - b. Design Flow Rate: **<Insert gpm (L/s)>**.
  - c. Design Inlet Pressure: **<Insert psig (kPa)>**.
  - d. Design Outlet Pressure Setting: **<Insert psig (kPa)>**.

## 2.6 AUTOMATIC CONTROL VALVES

### A. Bronze, Automatic Control Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Cast-bronze body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.



## B. Plastic, Automatic Control Valves:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Molded-plastic body, normally closed, diaphragm type with manual-flow adjustment, and operated by 24-V ac solenoid.

## 2.7 AUTOMATIC DRAIN VALVES

- A. Description: Spring-loaded-ball type of corrosion-resistant construction and designed to open for drainage if line pressure drops below
- 2-1/2 to 3 psig (17 to 20 kPa)**
- .

## 2.8 TRANSITION FITTINGS

- A. General Requirements: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

## B. Transition Couplings:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.

## C. Plastic-to-Metal Transition Fittings:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-socket[ **or threaded**] end.

## D. Plastic-to-Metal Transition Unions:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: MSS SP-107, PVC four-part union. Include one brass[ **or stainless-steel**] threaded end, one solvent-cement-joint[ **or threaded**] plastic end, rubber O-ring, and union nut.

## 2.9 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

## B. Dielectric Unions:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Factory-fabricated union, **NPS 2 (DN 50)** and smaller.
  - a. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**250 psig (1725 kPa)**] at **180 deg F (82 deg C)**.
  - b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.

## C. Dielectric Flanges:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Factory-fabricated, bolted, companion-flange assembly, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)** and larger.
  - a. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**175 psig (1200 kPa) minimum**] [**300 psig (2070 kPa)**].
  - b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

## D. Dielectric-Flange Kits:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Nonconducting materials for field assembly of companion flanges, **NPS 2-1/2 (DN 65)** and larger.
  - a. Pressure Rating: [**150 psig (1035 kPa) minimum**] **<Insert value>**.
  - b. Gasket: Neoprene or phenolic.
  - c. Bolt Sleeves: Phenolic or polyethylene.
  - d. Washers: Phenolic with steel backing washers.

## E. Dielectric Couplings:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Galvanized-steel coupling.
  - a. Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
  - b. End Connections: Female threaded.
  - c. Lining: Inert and noncorrosive, thermoplastic lining.

## F. Dielectric Nipples:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Electroplated steel nipple complying with ASTM F 1545.
  - a. Pressure Rating: [**300 psig (2070 kPa) at 225 deg F (107 deg C)**] **<Insert values>**.
  - b. End Connections: Male threaded or grooved.
  - c. Lining: Inert and noncorrosive, propylene.

## 2.10 MISCELLANEOUS PIPING SPECIALTIES

- A. Water Hammer Arresters: ASSE 1010 or PDI WH 201, with bellows or piston-type pressurized cushioning chamber and in sizes complying with PDI WH 201, Sizes A to F.
- B. Pressure Gages: ASME B40.1. Include **4-1/2-inch- (115-mm-)** diameter dial, dial range of two times system operating pressure, and bottom outlet.

## 2.11 SPRINKLERS

- A. General Requirements: Designed for uniform coverage over entire spray area indicated at available water pressure.
- B. Metal, Exposed, Impact-Drive Rotary Sprinklers:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Construction: Brass and other corrosion-resistant metals.
    - b. Mounting: Aboveground, exposed on riser.
  3. Capacities and Characteristics:
    - a. Flow: **<Insert gpm (L/s)>**.
    - b. Arc: **[Full] [Half] [Quarter]** **<Insert arc>** circle.
    - c. Radius: **<Insert feet (m)>**.
    - d. Inlet: **[NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)]** **<Insert value>**.
- C. Plastic, Exposed, Impact-Drive Rotary Sprinklers:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Construction: ABS and corrosion-resistant metals.
    - b. Mounting: Aboveground, exposed on riser.
  3. Capacities and Characteristics:
    - a. Flow: **<Insert gpm (L/s)>**.
    - b. Arc: **[Full] [Half] [Quarter]** **<Insert arc>** circle.
    - c. Radius: **<Insert feet (m)>**.
    - d. Inlet: **[NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)]** **<Insert size>**.
- D. Plastic, Pop-up, Gear-Drive Rotary Sprinklers:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description:
    - a. Body Material: ABS.
    - b. Nozzle: **[ABS] [Brass]**.
    - c. Retraction Spring: Stainless steel.
    - d. Internal Parts: Corrosion resistant.
  3. Capacities and Characteristics:
    - a. Flow: **<Insert gpm (L/s)>**.
    - b. Pop-up Height: **[4 inches (100 mm)]****<Insert inches (mm)>** aboveground to nozzle.

- c. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
- d. Radius: <Insert feet (m)>.
- e. Inlet: [NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)].

E. Metal, Pop-up, Impact-Drive Rotary Sprinklers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description:
  - a. Case: Brass.
  - b. Body Material: Brass.
  - c. Pop-up Height: [4 inches (100 mm)][Approximately 3 inches (75 mm)] <Insert value> aboveground to nozzle.
  - d. Sprinkler Construction: Brass and other corrosion-resistant metals.
3. Capacities and Characteristics:
  - a. Flow: <Insert gpm (L/s)>.
  - b. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
  - c. Radius: <Insert feet (m)>.
  - d. Inlet: [NPS 3/4 (DN 20)] [NPS 1-1/4 (DN 32)].

F. Plastic, Pop-up, Impact-Drive Rotary Sprinklers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description:
  - a. Case: ABS.
  - b. Pop-up Height: [4 inches (100 mm)][Approximately 3 inches (75 mm)] <Insert value> aboveground to nozzle.
  - c. Sprinkler Construction: ABS and other corrosion-resistant metals.
3. Capacities and Characteristics:
  - a. Nozzle: [ABS] [Brass].
  - b. Flow: <Insert gpm (L/s)>.
  - c. Arc: [Full] [Half] [Quarter] <Insert arc> circle.
  - d. Radius: <Insert feet (m)>.
  - e. Inlet: [NPS 3/4 (DN 20)] [NPS 1-1/4 (DN 32)].

G. Metal, Surface Spray Sprinklers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description:
  - a. Body Material and Flange: Brass.
  - b. Nozzle: Brass.
  - c. Pattern: Fixed, with flow adjustment.
3. Capacities and Characteristics:

- a. Flow: <Insert **gpm (L/s)**>.
- b. Arc: [**Full**] [**Half**] [**Quarter**] <Insert arc> circle.
- c. Radius: <Insert **feet (m)**>.
- d. Inlet: [**NPS 1/2 (DN 15)**] [**NPS 1/2 or NPS 3/4 (DN 15 or DN 20)**] [**NPS 3/4 (DN 20)**].

H. Plastic, Surface Spray Sprinklers:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description:
  - a. Body Material and Flange: ABS.
  - b. Pattern: Fixed, with flow adjustment.
- 3. Capacities and Characteristics:
  - a. Nozzle: [**ABS**] [**Brass**].
  - b. Flow: <Insert **gpm (L/s)**>.
  - c. Arc: [**Full**] [**Half**] [**Quarter**] <Insert arc> circle.
  - d. Radius: <Insert **feet (m)**>.
  - e. Inlet: [**NPS 1/2 (DN 15)**] [**NPS 1/2 or NPS 3/4 (DN 15 or DN 20)**] [**NPS 3/4 (DN 20)**].

I. Metal, Surface, Pop-up Spray Sprinklers:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description:
  - a. Body Material and Flange: Brass.
  - b. Nozzle: Brass.
  - c. Pattern: Fixed, with flow adjustment.
- 3. IgCC requires a minimum pop-up height of 4 inches (100 mm).Capacities and Characteristics:
  - a. Pop-up Height: [**4 inches (100 mm)**] [**1-1/4 or 1-1/2 inches (32 or 38 mm)**] [**1-3/4 or 2 inches (44 or 51 mm)**] <Insert value>.
  - b. Flow: <Insert **gpm (L/s)**>.
  - c. Arc: [**Full**] [**Half**] [**Quarter**] <Insert arc> circle.
  - d. Radius: <Insert **feet (m)**>.
  - e. Inlet: [**NPS 1/2 (DN 15)**] [**NPS 1/2 or NPS 3/4 (DN 15 or DN 20)**] [**NPS 3/4 (DN 20)**].

J. Plastic, Surface, Pop-up Spray Sprinklers:

- 1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- 2. Description:
  - a. Body Material and Flange: ABS.
  - b. Pattern: Fixed, with flow adjustment.

## 3. Capacities and Characteristics:

- a. Pop-up Height: [**4 inches (100 mm)**] [**1-1/4 or 1-1/2 inches (32 or 38 mm)**] [**1-3/4 or 2 inches (44 or 51 mm)**] <Insert value>.
- b. Nozzle: [**ABS**] [**Brass**].
- c. Flow: <Insert **gpm (L/s)**>.
- d. Arc: [**Full**] [**Half**] [**Quarter**] <Insert arc> circle.
- e. Radius: <Insert **feet (m)**>.
- f. Inlet: [**NPS 1/2 (DN 15)**] [**NPS 1/2 or NPS 3/4 (DN 15 or DN 20)**] [**NPS 3/4 (DN 20)**].

## K. Plastic, Pop-up Spray Sprinklers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Description:

- a. Body Material: ABS.
- b. Nozzle: [**ABS**] [**Brass**].
- c. Retraction Spring: Stainless steel.
- d. Internal Parts: Corrosion resistant.
- e. Pattern: Fixed, with flow adjustment.

## 3. Capacities and Characteristics:

- a. Nozzle: [**ABS**] [**Brass**].
- b. Flow: <Insert **gpm (L/s)**>.
- c. Pop-up Height: [**4 inches (100 mm)**] <Insert inches (mm)> aboveground to nozzle.
- d. Arc: [**Full**] [**Half**] [**Quarter**] <Insert arc> circle.
- e. Radius: <Insert **feet (m)**>.
- f. Inlet: [**NPS 1/2 (DN 15)**] [**NPS 1/2 or NPS 3/4 (DN 15 or DN 20)**] [**NPS 3/4 (DN 20)**].

## L. Metal Shrub Sprinklers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Description:

- a. Body Material: Brass.
- b. Nozzle: Brass.
- c. Pattern: Fixed, with flow adjustment.

## 3. Capacities and Characteristics:

- a. Configuration: <Insert description>.
- b. Flow: <Insert **gpm (L/s)**>.
- c. Arc: [**Full**] [**Half**] [**Quarter**] <Insert arc> circle.
- d. Radius: <Insert **feet (m)**>.
- e. Mounting Height: <Insert inches (mm)> aboveground to nozzle.
- f. Inlet: [**NPS 1/2 (DN 15)**] [**NPS 1/2 or NPS 3/4 (DN 15 or DN 20)**] [**NPS 3/4 (DN 20)**].

## M. Plastic Shrub Sprinklers:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description:
  - a. Body Material: ABS or other plastic.
  - b. Pattern: Fixed, with flow adjustment.
3. Capacities and Characteristics:
  - a. Configuration: **<Insert description>**.
  - b. Flow: **<Insert gpm (L/s)>**.
  - c. Arc: **[Full] [Half] [Quarter]** **<Insert arc>** circle.
  - d. Radius: **<Insert feet (m)>**.
  - e. Mounting Height: **<Insert inches (mm)>** aboveground to nozzle.
  - f. Inlet: **[NPS 1/2 (DN 15)] [NPS 1/2 or NPS 3/4 (DN 15 or DN 20)] [NPS 3/4 (DN 20)]**.

## 2.12 QUICK COUPLERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description: Factory-fabricated, bronze or brass, two-piece assembly. Include coupler water-seal valve; removable upper body with spring-loaded or weighted, rubber-covered cap; hose swivel with ASME B1.20.7, 3/4-11.5NH threads for garden hose on outlet; and operating key.
  1. Locking-Top Option: Vandal-resistant locking feature. Include **[one] [two]** **<Insert number>** matching key(s).

## 2.13 DRIP IRRIGATION SPECIALTIES

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Freestanding Emitters: Device to deliver water at approximately **20 psig (138 kPa)**.
  1. Body Material: PE or vinyl, with flow control.
  2. Riser to Emitter: PE or PVC flexible tubing.
  3. Capacities and Characteristics:
    - a. Flow: **[1/2 gph (1.9 L/h)] [1 gph (3.8 L/h)] [2 gph (7.6 L/h)]** **<Insert value>** at approximately **20 psig (138 kPa)**.
    - b. Tubing: PE or PVC; **1/8-inch (3-mm)** minimum ID.
    - c. Mounting Height: **<Insert dimension>** aboveground to nozzle.
- C. Manifold Emitter Systems: Manifold with tubing and emitters.
  1. Manifold: With multiple outlets to deliver water to emitters.
    - a. Body Material: Plastic.
    - b. Outlet Caps: Plastic, for outlets without installed tubing.

- c. Operation: Automatic pressure compensating.
  - 2. Tubing: PE or PVC; 1/8-inch (3-mm) minimum ID.
  - 3. Emitter: Device to deliver water at approximately 20 psig (138 kPa).
    - a. Body Material: PE or vinyl, with flow control.
  - 4. Capacities and Characteristics:
    - a. Manifold:
      - 1) Design Flow: <Insert gph (L/h)>.
      - 2) Number of Outlets: [Four] [Six] <Insert number>.
    - b. Emitter No.: <Insert number>.
      - 1) Flow: [1/2 gph (1.9 L/h)] [1 gph (3.8 L/h)] [2 gph (7.6 L/h)] <Insert value> at approximately 20 psig (138 kPa).
      - 2) Mounting Height: [At ground] [As indicated] <Insert dimension>.
- D. Multiple-Outlet Emitter Systems: Emitter with tubing and button-type outlets.
  - 1. Emitter: With multiple outlets to deliver water to remote outlets.
    - a. Body Material: Plastic, with flow control.
    - b. Outlet Caps: Plastic, for outlets without installed tubing.
    - c. Operation: Automatic pressure compensating.
    - d. Emitters: Devices to deliver water at approximately 20 psig (138 kPa.)
  - 2. Tubing: PE or PVC; 1/8-inch (3-mm) minimum ID.
  - 3. Capacities and Characteristics:
    - a. Emitter:
      - 1) Flow: [1/2 gph (1.9 L/h)] [1 gph (3.8 L/h)] [2 gph (7.6 L/h)] <Insert value>.
      - 2) Number of Outlets: [Four] [Six] <Insert number>.
    - b. Button-Type Outlet No.: <Insert number>.
      - 1) Mounting Height: [At ground] [As indicated] <Insert dimension>.
- E. Drip Tubes with Direct-Attached Emitters:
  - 1. Tubing: Flexible PE or PVC with plugged end.
  - 2. Emitters: Devices to deliver water at approximately 20 psig (138 kPa).
    - a. Body Material: PE or vinyl, with flow control.
    - b. Mounting: Inserted into tubing at set intervals.
  - 3. Capacities and Characteristics:



- a. Tubing Size: [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] [**NPS 1 (DN 25)**] <Insert value>.
  - b. Length: <Insert inches (mm)>.
  - c. Emitter Spacing: <Insert inches (mm)>.
  - d. Emitter Flow: [**1/2 gph (1.9 L/h)**] [**1 gph (3.8 L/h)**] [**2 gph (7.6 L/h)**] <Insert value>.
- F. Drip Tubes with Remote Discharge:
- 1. Tubing: Flexible PE or PVC with plugged end.
  - 2. Emitters: Devices to deliver water at approximately **20 psig (138 kPa)**.
    - a. Body Material: PE or vinyl, with flow control.
    - b. Mounting: Inserted into tubing at set intervals.
  - 3. Capacities and Characteristics:
    - a. Tubing Size: [**NPS 1/2 (DN 15)**] [**NPS 3/4 (DN 20)**] [**NPS 1 (DN 25)**] <Insert value>.
    - b. Length: <Insert inches (mm)>.
    - c. Emitter Spacing: <Insert inches (mm)>.
    - d. Emitter Flow: [**1/2 gph (1.9 L/h)**] [**1 gph (3.8 L/h)**] [**2 gph (7.6 L/h)**] <Insert value>.
    - e. Branch Tubing Size: [**NPS 1/4 (DN 8)**] <Insert value> with button-type outlet.
    - f. Branch Tubing Length: <Insert inches (mm)>.
- G. Off-Ground Supports: Plastic stakes.
- H. Application Pressure Regulators: Brass or plastic housing, **NPS 3/4 (DN 20)**, with corrosion-resistant internal parts; capable of controlling outlet pressure to approximately **20 psig (138 kPa)**.
- I. Filter Units: Brass or plastic housing, with corrosion-resistant internal parts; of size and capacity required for devices downstream from unit.
- J. Air Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.
- K. Vacuum Relief Valves: Brass or plastic housing, with corrosion-resistant internal parts.

## 2.14 CONTROLLERS

- A. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Description:
  - 1. Controller Stations for Automatic Control Valves: Each station is variable from approximately [**5 to 60**] <Insert numbers> minutes. Include switch for manual or automatic operation of each station.
  - 2. Exterior Control Enclosures: NEMA 250, Type 4, weatherproof, with locking cover and [**two**] <Insert number> matching keys; include provision for grounding.

- a. Body Material: **[Enameled-steel sheet metal]** **[Stainless-steel sheet metal]** **[Molded plastic]**.
  - b. Mounting: **[Freestanding type for concrete base]** **[Surface type for wall]**.
3. Interior Control Enclosures: NEMA 250, Type 12, dripproof, with locking cover and **[two]** **<Insert number>** matching keys.
    - a. Body Material: **[Enameled-steel sheet metal]** **[Stainless-steel sheet metal]** **[Molded plastic]**.
    - b. Mounting: **[Freestanding type for concrete base]** **[Surface type for wall]**.
  4. Control Transformer: 24-V secondary, with primary fuse.
  5. Timing Device: Adjustable, 24-hour, 14-day clock, with automatic operations to skip operation any day in timer period, to operate every other day, or to operate two or more times daily.
    - a. Manual or Semiautomatic Operation: Allows this mode without disturbing preset automatic operation.
    - b. Nickel-Cadmium Battery and Trickle Charger: Automatically powers timing device during power outages.
    - c. Surge Protection: Metal-oxide-varistor type on each station and primary power.
  6. Moisture Sensor: Adjustable from one to seven days, to shut off water flow during rain.
  7. Smart Controllers: Use ET, tested in accordance with IA SWAT Climatological Based Controllers 8<sup>th</sup> Draft Testing Protocol and compliant with ASHRAE Standard 189.1.
  8. Wiring: UL 493, Type UF multiconductor, with solid-copper conductors; insulated cable; suitable for direct burial.
    - a. Feeder-Circuit Cables: No. 12 AWG minimum, between building and controllers.
    - b. Low-Voltage, Branch-Circuit Cables: No. 14 AWG minimum, between controllers and automatic control valves; color-coded different from feeder-circuit-cable jacket color; with jackets of different colors for multiple-cable installation in same trench.
    - c. Splicing Materials: Manufacturer's packaged kit consisting of insulating, spring-type connector or crimped joint and epoxy resin moisture seal; suitable for direct burial.
  9. Concrete Base: Reinforced precast concrete not less than **36 by 24 by 4 inches (900 by 600 by 100 mm)** thick, and **6 inches (150 mm)** greater in each direction than overall dimensions of controller. Include opening for wiring.

## 2.15 BOXES FOR AUTOMATIC CONTROL VALVES

### A. Plastic Boxes:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.
  - a. Size: As required for valves and service.

- b. Shape: **[Round]** **[Square]** **[Rectangular]**.
- c. Sidewall Material: **[PE]** **[PE, ABS, or FRP]** **<Insert material>**.
- d. Cover Material: **[PE]** **[PE, ABS, or FRP]** **<Insert material>**.

1) Lettering: "[VALVE BOX] [IRRIGATION] **<Insert lettering>**."

B. Polymer-Concrete Boxes:

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Description: Box and cover, with open bottom and openings for piping; designed for installing flush with grade.

- a. Size: As required for valves and service.
- b. Shape: **[Round]** **[Square]** **[Rectangular]**.
- c. Sidewall Material: Polymer concrete with lateral and vertical sidewall design loading of **[5000 lb (2268 kg)]** **[10,000 lb (4536 kg)]** **[15,000 lb (6800 kg)]** minimum over **10 by 10 inches (254 by 254 mm)** square.
- d. Cover Material: **[Polymer concrete]** **[Reinforced polymer concrete]** **<Insert material>** with cover design loading of **[5000 lb (2268 kg)]** **[10,000 lb (4536 kg)]** **[15,000 lb (6800 kg)]** minimum over **10 by 10 inches (254 by 254 mm)** square.

1) Lettering: "[VALVE BOX] [IRRIGATION] **<Insert lettering>**."

C. Drainage Backfill: Cleaned gravel or crushed stone, graded from **3/4 inch (19 mm)** minimum to **3 inches (75 mm)** maximum.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, **[12 inches (300 mm)]** **<Insert value>** below finished grades, except **6 inches (150 mm)** below subgrade under pavement and slabs.
- C. Drain Pockets: Excavate to sizes indicated. Backfill with cleaned gravel or crushed stone, graded from **[3/4 to 3 inches (19 to 75 mm)]** **<Insert value>**, to **[12 inches (300 mm)]** **<Insert value>** below grade. Cover gravel or crushed stone with sheet of asphalt-saturated felt and backfill remainder with excavated material.
- D. Provide minimum cover over top of underground piping according to the following:
  - 1. Irrigation Main Piping: Minimum depth of **[36 inches (900 mm)]** **<Insert value>** below finished grade, or not less than **[18 inches (450 mm)]** **<Insert value>** below average local frost depth, whichever is deeper.
  - 2. Circuit Piping: **[12 inches (300 mm)]** **<Insert value>**.
  - 3. Drain Piping: **[12 inches (300 mm)]** **<Insert value>**.
  - 4. Sleeves: **[24 inches (600 mm)]** **<Insert value>**.

### 3.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

### 3.3 PIPING INSTALLATION

- A. Location and Arrangement: Drawings indicate location and arrangement of piping systems. Install piping as indicated unless deviations are approved on Coordination Drawings.
- B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.
- C. Install piping free of sags and bends.
- D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
- E. Install fittings for changes in direction and branch connections.
- F. Install unions adjacent to valves and to final connections to other components with **NPS 2 (DN 50)** or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with **NPS 2-1/2 (DN 65)** or larger pipe connection.
- H. Install underground thermoplastic piping according to ASTM D 2774[ **and ASTM F 690**].
- I. Install expansion loops in control-valve boxes for plastic piping.
- J. Lay piping on solid subbase, uniformly sloped without humps or depressions.
- K. Install ductile-iron piping according to AWWA C600.
- L. Install PVC piping in dry weather when temperature is above **40 deg F (5 deg C)**. Allow joints to cure at least 24 hours at temperatures above **40 deg F (5 deg C)** before testing.
- M. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.
- N. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.
- O. Install piping in sleeves under parking lots, roadways, and sidewalks.
- P. Install sleeves made of [**Schedule 40**] [**Schedule 80**] PVC pipe and socket fittings, and solvent-cemented joints.
- Q. Install transition fittings for plastic-to-metal pipe connections according to the following:
  - 1. Underground Piping:
    - a. **NPS 1-1/2 (DN 40)** and Smaller: Plastic-to-metal transition fittings.

- b. **NPS 2 (DN 50)** and Larger: AWWA transition couplings.
  - 2. Aboveground Piping:
    - a. **NPS 2 (DN 50)** and Smaller: Plastic-to-metal transition [**fittings**] [**unions**].
    - b. **NPS 2 (DN 50)** and Larger: Use dielectric flange kits with one plastic flange.
- R. Install dielectric fittings for dissimilar-metal pipe connections according to the following:
  - 1. Underground Piping:
    - a. **NPS 2 (DN 50)** and Smaller: Dielectric coupling or dielectric nipple.
    - b. **NPS 2-1/2 (DN 65)** and Larger: Prohibited except in control-valve box.
  - 2. Aboveground Piping:
    - a. **NPS 2 (DN 50)** and Smaller: Dielectric union.
    - b. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Dielectric flange.
    - c. **NPS 5 (DN 125)** and Larger: Dielectric flange kit.
  - 3. Piping in Control-Valve Boxes:
    - a. **NPS 2 (DN 50)** and Smaller: Dielectric union.
    - b. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Dielectric flange.
    - c. **NPS 5 (DN 125)** and Larger: Dielectric flange kit.

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Flanged Joints: Select rubber gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- E. Ductile-Iron Piping Gasketed Joints: Comply with AWWA C600 and AWWA M41.
- F. Copper-Tubing Brazed Joints: Construct joints according to CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.

- G. Copper-Tubing Soldered Joints: Apply ASTM B 813 water-flushable flux to tube end unless otherwise indicated. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners according to piping manufacturer's written instructions.
- I. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
  - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- J. PVC Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. PVC Pressure Piping: Join schedule number, ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 3. PVC Nonpressure Piping: Join according to ASTM D 2855.

### 3.5 VALVE INSTALLATION

- A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.
- B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
  - 1. Install valves and PVC pipe with restrained, gasketed joints.
- C. Aboveground Valves: Install as components of connected piping system.
- D. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves. [**Install full-size valved bypass.**]
- E. Throttling Valves: Install in underground piping in boxes for automatic control valves.
- F. Drain Valves: Install in underground piping in boxes for automatic control valves.

### 3.6 SPRINKLER INSTALLATION

- A. Install sprinklers after hydrostatic test is completed.
- B. Install sprinklers at manufacturer's recommended heights.
- C. Locate part-circle sprinklers to maintain a minimum distance of **4 inches (100 mm)** from walls and **2 inches (50 mm)** from other boundaries unless otherwise indicated.

### 3.7 DRIP IRRIGATION SPECIALTY INSTALLATION

- A. Install freestanding emitters on pipe riser to mounting height indicated.
- B. Install manifold emitter systems with tubing to emitters. Plug unused manifold outlets. Install emitters on off-ground supports at height indicated.
- C. Install multiple-outlet emitter systems with tubing to outlets. Plug unused emitter outlets. Install outlets on off-ground supports at height indicated.
- D. Install drip tubes with direct-attached emitters on ground.
- E. Install drip tubes with remote-discharge on ground with outlets on off-ground supports at height indicated.
- F. Install off-ground supports of length required for indicated mounted height of device.
- G. Install [**application pressure regulators**] [**and**] [**filter units**] in piping near device being protected, and [**aboveground**] [**in control-valve boxes**].
- H. Install [**air relief valves**] [**and**] [**vacuum relief valves**] in piping, and [**aboveground**] [**in control-valve boxes**].

### 3.8 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

- A. Equipment Mounting: Install interior controllers on [**floor**] [**concrete bases**] [**wall**].
  - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- B. Equipment Mounting: Install exterior freestanding controllers on precast concrete bases.
  - 1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 2. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Install control cable in same trench as irrigation piping and at least **2 inches (51 mm)** below[ **or beside**] piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

### 3.9 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

- C. Connect wiring between controllers and automatic control valves.

### 3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.
  - 1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Warning Tapes: Arrange for installation of continuous, underground, detectable warning tapes over underground piping during backfilling of trenches. See Section 312000 "Earth Moving" for warning tapes.

### 3.11 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Any irrigation product will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.12 STARTUP SERVICE

- A. **[Engage a factory-authorized service representative to perform] [Perform]** startup service.
  - 1. Complete installation and startup checks according to manufacturer's written instructions.
  - 2. Verify that controllers are installed and connected according to the Contract Documents.
  - 3. Verify that electrical wiring installation complies with manufacturer's submittal.



## 3.13 ADJUSTING

- A. Adjust settings of controllers.
- B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.
- C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than [**1/2 inch (13 mm)**] <Insert value> above, finish grade.

## 3.14 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

## 3.15 DEMONSTRATION

- A. [**Engage a factory-authorized service representative to train**] [**Train**] Owner's maintenance personnel to adjust, operate, and maintain [**automatic control valves**] [**and**] [**controllers**].

## 3.16 PIPING SCHEDULE

- A. Install components having pressure rating equal to or greater than system operating pressure.
- B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
- C. Aboveground irrigation main piping, [**NPS 4 (DN 100) and smaller**] <Insert pipe size range>, shall be[ **one of**] the following:
  - 1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
  - 2. [**Type L (Type B)**] [**Type M (Type C)**] hard copper tube, wrought- or cast-copper fittings, and [**brazed**] [**soldered**] joints.
  - 3. [**Schedule 40**] [**Schedule 80**], PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
  - 4. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
- D. Aboveground irrigation main piping, [**NPS 5 (DN 125) and larger**] <Insert pipe size range>, shall be[ **one of**] the following:
  - 1. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
  - 2. [**Schedule 40**] [**Schedule 80**], PVC pipe and socket fittings; and solvent-cemented joints.
  - 3. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
- E. Underground irrigation main piping, [**NPS 4 (DN 100) and smaller**] <Insert pipe size range>, shall be[ **one of**] the following:

1. **NPS 3 and NPS 4 (DN 80 and DN 100)** ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings, glands, bolts, and nuts; and gasketed joints.
  2. **NPS 3 and NPS 4 (DN 80 and DN 100)** ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.
  3. **Type L (Type B)** soft copper tube, wrought-copper fittings, and brazed joints.
  4. **NPS 4 (DN 100)** PE pressure pipe; PE butt, heat-fusion or socket-type fittings; and heat-fusion joints.
  5. **[Schedule 40] [Schedule 80]**, PVC pipe and socket fittings, and solvent-cemented joints.
  6. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
  7. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
- F. Underground irrigation main piping, **[NPS 5 (DN 125) and larger]** <Insert pipe size range>, shall be[ **one of**] the following:
1. **NPS 6 (DN 150)** and larger ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings, glands, bolts, and nuts; and gasketed joints.
  2. **NPS 6 (DN 150)** and larger ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.
  3. PE pressure pipe; PE butt, heat-fusion fittings; and heat-fusion joints.
  4. **[Schedule 40] [Schedule 80]**, PVC pipe and socket fittings; and solvent-cemented joints.
  5. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
- G. Circuit piping, **[NPS 2 (DN 50) and smaller]** <Insert pipe size range>, shall be[ **one of**] the following:
1. **[SIDR 7] [SIDR 9]**, PE, controlled ID pipe; insert fittings for PE pipe; and fastener joints.
  2. **[DR 9] [DR 11]**, PE, controlled OD pipe; PE butt, heat-fusion, or PE socket-type fittings; and heat-fusion joints.
  3. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
  4. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
- H. Circuit piping, **[NPS 2-1/2 to NPS 4 (DN 65 to DN 100)]** <Insert pipe size range>, shall be[ **one of**] the following:
1. **[SIDR 7] [SIDR 9]**, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
  2. **[DR 9] [DR 11]**, PE, controlled OD pipe; PE socket or butt-fusion fittings; and heat-fusion joints. **NPS 3 (DN 80)** pipe and fittings if **NPS 2-1/2 (DN 65)** pipe and fittings are not available.
  3. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
  4. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
- I. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.

1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
- J. Risers to Aboveground Sprinklers and Specialties: [**Type L (Type B)**] [**Type M (Type C)**] hard copper tube, wrought-copper fittings, and [**brazed**] [**soldered**] joints.
- K. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.
- L. Drain piping shall be[ **one of**] the following:
  1. SDR 9, 11.5, or 15, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
  2. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
  3. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

### 3.17 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:
  1. **NPS 2 (DN 50)** and Smaller: Curb valve, curb-valve casing, and shutoff rod.
  2. **NPS 3 (DN 80)** and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).
- B. Aboveground, Shutoff-Duty Valves:
  1. **NPS 2 (DN 50)** and Smaller: [**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.
  2. **NPS 2 (DN 50)** and Smaller: Bronze gate valve.
  3. **NPS 2-1/2 (DN 65)** and Larger: Iron ball valve.
  4. **NPS 2-1/2 (DN 65)** and Larger: Iron gate valve, [**NRS**] [**OS&Y**].
- C. Throttling-Duty Valves:
  1. **NPS 2 (DN 50)** and Smaller: [**Bronze**] [**Plastic**] automatic control valve.
  2. **NPS 2 (DN 50)** and Smaller: [**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.
  3. **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**: [**Bronze**] [**Plastic**] automatic control valve.
  4. **NPS 2-1/2 and NPS 3 (DN 65 and DN 80)**: Iron ball valve.
- D. Drain Valves:
  1. **NPS 1/2 and NPS 3/4 (DN 15 and DN 20)**: Automatic drain valve.
  2. **NPS 1/2 and NPS 3/4 (DN 15 and DN 20)**: [**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.
  3. **NPS 1/2 and NPS 3/4 (DN 15 and DN 20)**: Bronze gate valve.
  4. **NPS 1 to NPS 2 (DN 25 to DN 50)**: [**Brass**] [**Brass or bronze**] [**Bronze**] [**Plastic**] ball valve.
  5. **NPS 1 to NPS 2 (DN 25 to DN 50)**: Bronze gate valve.

END OF SECTION 328400

## SECTION 329113 - SOIL PREPARATION

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 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 planting soils[ **and layered soil assemblies**] specified by composition of the mixes.
- B. Related Requirements:
1. Section 129200 "Interior Planters and Artificial Plants" for placing planting soil in planters for live interior plants.
  2. Section 129300 "Site Furnishings" for placing planting soil in exterior unit planters.
  3. Section 311000 "Site Clearing" for topsoil stripping and stockpiling.
  4. Section 321443 "Porous Unit Paving" for placing planting-soil fill in porous paving.
  5. Section 329200 "Turf and Grasses" for placing planting soil for turf and grasses.
  6. Section 329300 "Plants" for placing planting soil for plantings.
  7. Section 329600 "Transplanting" for placing planting soil in tree planting pits.
  8. Section 329700 "Vegetated Roof Assemblies" for growing media (soil).

## 1.3 ALLOWANCES

- A. [**Preconstruction**] [**and**] [**field quality-control**] testing [**is**] [**are**] part of testing and inspecting allowance.

## 1.4 UNIT PRICES

- A. Work of this Section is affected by [**unit prices specified in Section 012200 "Unit Prices."**] **<Insert name of unit price.>**

## 1.5 DEFINITIONS

- A. AAPFCO: Association of American Plant Food Control Officials.
- B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
- C. CEC: Cation exchange capacity.
- D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
- E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
- F. Imported Soil: Soil that is transported to Project site for use.
- G. Layered Soil Assembly: A designed series of planting soils, layered on each other, that together produce an environment for plant growth.
- H. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce planting soil.
- I. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.
- J. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.
- L. RCRA Metals: Hazardous metals identified by the EPA under the Resource Conservation and Recovery Act.
- M. SSSA: Soil Science Society of America.
- N. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.
- O. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.
- P. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil"; but in disturbed areas such as urban environments, the surface soil can be subsoil.
- Q. USCC: U.S. Composting Council.

## 1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** **<Insert location>**.

## 1.7 ACTION SUBMITTALS

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

1. Include recommendations for application and use.
2. Include test data substantiating that products comply with requirements.
3. Include sieve analyses for aggregate materials.
4. Material Certificates: For each type of **[imported soil]** **[and]** **[soil amendment and fertilizer]** **<Insert item>** before delivery to the site, according to the following:
  - a. Manufacturer's qualified testing agency's certified analysis of standard products.
  - b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
  - c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

- B. Sustainable Design Submittals:

1. **<Double click to insert sustainable design text for regional materials.>**

- C. Samples: For each bulk-supplied material, **[1-quart (1-L)]** **[1-gal. (4-L)]** **<Insert value>** volume of each in sealed containers labeled with content, source, and date obtained. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of composition, color, and texture.

## 1.8 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For each testing agency.
- B. Preconstruction Test Reports: For preconstruction soil analyses specified in "Preconstruction Testing" Article.
- C. Field quality-control reports.

## 1.9 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.
1. Laboratories: Subject to compliance with requirements, **[provide testing by the following]** **[provide testing by one of the following]**:
    - a. **<Insert laboratory's name and address>**.

2. Multiple Laboratories: At Contractor's option, work may be divided among qualified testing laboratories specializing in physical testing, chemical testing, and fertility testing.

#### 1.10 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage] [Engage]** a qualified testing agency to perform preconstruction soil analyses on **[existing, on-site soil] [imported soil] <Insert item>**.
  1. Notify Architect **[seven] <Insert number>** days in advance of the dates and times when laboratory samples will be taken.
- B. Preconstruction Soil Analyses: For each unamended soil type, perform testing on soil samples and furnish soil analysis and a written report containing soil-amendment and fertilizer recommendations by a qualified testing agency performing the testing according to "Soil-Sampling Requirements" and "Testing Requirements" articles.
  1. Have testing agency identify and label samples and test reports according to sample collection and labeling requirements.

#### 1.11 SOIL-SAMPLING REQUIREMENTS

- A. General: Extract soil samples according to requirements in this article.
- B. Sample Collection and Labeling: Have samples taken and labeled by **[Owner] [Contractor in presence of Architect] [soil scientist (CPSS) certified by SSSA] [soil classifier (CPSC) certified by SSSA] [soil scientist (RPSS) registered by the National Society of Consulting Soil Scientists] [or] [state-certified, -licensed, or -registered soil scientist] <Insert requirement>** under the direction of the testing agency.
  1. Number and Location of Samples: Minimum of **[three] [eight] <Insert number>** representative soil samples **[from varied locations] [where indicated on Drawings] [where directed by Architect] <Insert requirement>** for each soil to be used or amended for landscaping purposes.
  2. Procedures and Depth of Samples: **[According to USDA-NRCS's "Field Book for Describing and Sampling Soils." ] [As directed by Architect.] <Insert requirement.>**
  3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
  4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

#### 1.12 TESTING REQUIREMENTS

- A. General: Perform tests on soil samples according to requirements in this article.
- B. Physical Testing:
  1. Soil Texture: Soil-particle, size-distribution analysis by **[one of]** the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods":

- a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
  - b. Hydrometer Method: Report percentages of sand, silt, and clay.
2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
  3. Water Retention: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
  4. Saturated Hydraulic Conductivity: According to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods"; at 85% compaction according to ASTM D 698 (Standard Proctor).
- C. Chemical Testing:
1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
  2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
  3. Metals Hazardous to Human Health: Test for presence and quantities of RCRA metals including aluminum, arsenic, barium, copper, cadmium, chromium, cobalt, lead, lithium, and vanadium. If RCRA metals are present, include recommendations for corrective action.
  4. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.
- D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of [SSSA NAPT NCR-13] [SSSA NAPT NEC-67] [SSSA NAPT SERA-6] [SSSA NAPT WERA-103], including the following:
1. Percentage of organic matter.
  2. CEC, calcium percent of CEC, and magnesium percent of CEC.
  3. Soil reaction (acidity/alkalinity pH value).
  4. Buffered acidity or alkalinity.
  5. Nitrogen ppm.
  6. Phosphorous ppm.
  7. Potassium ppm.
  8. Manganese ppm.
  9. Manganese-availability ppm.
  10. Zinc ppm.
  11. Zinc availability ppm.
  12. Copper ppm.
  13. Sodium ppm[ **and sodium absorption ratio**].
  14. Soluble-salts ppm.
  15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
  16. Other deleterious materials, including their characteristics and content of each.



- E. Organic-Matter Content: Analysis using loss-by-ignition method according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
- F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.
  - 1. Fertilizers and Soil Amendment Rates: State recommendations in weight [**per 1000 sq. ft. (100 sq. m) for 6-inch (150-mm) depth of soil**] <Insert requirement>.
  - 2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight [**per 1000 sq. ft. (100 sq. m) for 6-inch (150-mm) depth of soil**] <Insert requirement>.

### 1.13 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Do not move or handle materials when they are wet or frozen.
  - 4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. [<Double click to insert sustainable design text for regional materials.>](#)

### 2.2 PLANTING SOILS SPECIFIED BY COMPOSITION

- A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.
- B. Planting-Soil Type <Insert drawing designation>: Existing, on-site surface soil, with the duff layer, if any, retained[; **and stockpiled on-site**]; modified to produce viable planting soil. Blend existing, on-site surface soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:

1. Ratio of Loose Compost to Soil: [1:4] [1:3] [1:2] <Insert ratio> by volume.
  2. Ratio of Loose [Sphagnum] [Muck] Peat to Soil: <Insert ratio> by volume.
  3. Ratio of Loose Wood Derivatives Soil: <Insert ratio> by volume.
  4. Weight of Lime: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  5. Weight of [Sulfur] [Iron Sulfate]: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  6. Weight of Agricultural Gypsum: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  7. Weight of Superphosphate: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  8. Weight of Commercial Fertilizer: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  9. Weight of Slow-Release Fertilizer: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
- C. Planting-Soil Type <Insert drawing designation>: Imported, naturally formed soil from off-site sources and consisting of [sandy loam] [loam] [silt loam] [loamy sand] [or] [sand] soil <Insert soil texture> according to USDA textures; and modified to produce viable planting soil.
1. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches (100 mm) deep, not from [agricultural land, ]bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
  2. Additional Properties of Imported Soil before Amending: Soil reaction of [pH 6 to 7] <Insert range> and minimum of [2] [4] [6] <Insert number> percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
  3. Unacceptable Properties: Clean soil of the following:
    - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of [8] <Insert number> percent by dry weight of the imported soil.
    - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> in any dimension.
  4. Amended Soil Composition: Blend imported, unamended soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
    - a. Ratio of Loose Compost to Soil: [1:4] [1:3] [1:2] <Insert ratio> by volume.
    - b. Ratio of Loose [Sphagnum] [Muck] Peat to Soil: <Insert ratio> by volume.
    - c. Ratio of Loose Wood Derivatives to Soil: <Insert ratio> by volume.
    - d. Weight of Lime: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.

- e. Weight of [Sulfur] [Iron Sulfate]: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  - f. Weight of Agricultural Gypsum: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  - g. Weight of Superphosphate: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  - h. Weight of Commercial Fertilizer: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
  - i. Weight of Slow-Release Fertilizer: <Insert weight> per [1000 sq. ft. (100 sq. m)] <Insert area> per [6 inches (150 mm)] <Insert dimension> of soil depth.
- D. Planting-Soil Type <Insert drawing designation>: Manufactured soil consisting of manufacturer's basic [topsoil,] [sandy loam according to USDA textures,] <Insert soil texture or manufacturer's base-soil designation> blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of [pH 6 to 7] <Insert range> and minimum of [2] [4] [6] <Insert number> percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
  3. Unacceptable Properties: Manufactured soil shall not contain the following:
    - a. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
    - b. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of [5] <Insert number> percent by dry weight of the manufactured soil.
    - c. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding [1-1/2 inches (38 mm)] [2 inches (50 mm)] <Insert dimension> in any dimension.
  4. Blend manufacturer's basic soil with the following soil amendments and fertilizers in the following quantities to produce planting soil:
    - a. Ratio of Loose Compost to Soil: [1:4] [1:3] [1:2] <Insert ratio> by volume.
    - b. Ratio of Loose [Sphagnum] [Muck] Peat to Soil: <Insert ratio> by volume.
    - c. Ratio of Loose Wood Derivatives Soil: <Insert ratio> by volume.
    - d. Volume of Sand: <Insert volume> per [cu. yd. (cu. m)] <Insert value>.
    - e. Volume of Perlite: <Insert volume> per [cu. yd. (cu. m)] <Insert value>.
    - f. Weight of Lime: <Insert weight> per [cu. yd. (cu. m)] <Insert value>.
    - g. Weight of [Sulfur] [Iron Sulfate]: <Insert weight> per [cu. yd. (cu. m)] <Insert value>.
    - h. Weight of Agricultural Gypsum: <Insert weight> per [cu. yd. (cu. m)] <Insert value>.
    - i. Weight of Superphosphate: <Insert weight> per [cu. yd. (cu. m)] <Insert value>.
    - j. Weight of Commercial Fertilizer: <Insert weight> per [cu. yd. (cu. m)] <Insert value>.

- k. Weight of Slow-Release Fertilizer: <Insert weight> per [cu. yd. (cu. m)] <Insert value>.

### 2.3 INORGANIC SOIL AMENDMENTS

- A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:
1. Class: T, with a minimum of 99 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through a No. 60 (0.25-mm) sieve.
  2. Class: O, with a minimum of 95 percent passing through a No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through a No. 60 (0.25-mm) sieve.
  3. Form: Provide lime in form of ground [dolomitic limestone] [calcitic limestone] [mollusk shells] <Insert material>.
- B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with a minimum of 99 percent passing through a No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through a No. 40 (0.425-mm) sieve.
- C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.
- D. Perlite: Horticultural perlite, soil amendment grade.
- E. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through a No. 50 (0.30-mm) sieve.
- F. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to [ASTM C 33/C 33M] <Insert requirement>.

### 2.4 ORGANIC SOIL AMENDMENTS

- A. Compost: Well-composted, stable, and weed-free organic matter produced by composting feedstock, and bearing USCC's "Seal of Testing Assurance," and as follows:
1. Feedstock: [Limited to leaves] [May include sewage sludge] [May include animal waste] <Insert requirement>.
  2. Reaction: [pH of 5.5 to 8] <Insert range>.
  3. Soluble-Salt Concentration: Less than [4] <Insert value> dS/m.
  4. Moisture Content: [35 to 55] <Insert number range> percent by weight.
  5. Organic-Matter Content: [30 to 40] [50 to 60] <Insert number range> percent of dry weight.
  6. Particle Size: Minimum of 98 percent passing through a [4-inch (100-mm)] [2-inch (50-mm)] [1-inch (25-mm)] [1/2-inch (13-mm)] sieve.
- B. Sphagnum Peat: Partially decomposed sphagnum peat moss, finely divided or of granular texture with 100 percent passing through a [1/2-inch (13-mm)] <Insert dimension> sieve, a pH of 3.4 to 4.8, and a soluble-salt content measured by electrical conductivity of [maximum 5] <Insert value or range> dS/m.

- C. Muck Peat: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture with 100 percent passing through a [**1/2-inch (13-mm)**] <Insert dimension> sieve, a pH of 6 to 7.5, a soluble-salt content measured by electrical conductivity of [**maximum 5**] <Insert value or range> dS/m, having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Wood Derivatives: Shredded and composted, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.
  - 1. Partially Decomposed Wood Derivatives: In lieu of shredded and composted wood derivatives, mix shredded and partially decomposed wood derivatives with ammonium nitrate at a minimum rate of [**0.15 lb/cu. ft. (2.4 kg/cu. m)**] <Insert value> of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of [**0.25 lb/cu. ft. (4 kg/cu. m)**] <Insert value> of loose sawdust or ground bark.
- E. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

## 2.5 FERTILIZERS

- A. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of [**20**] [**33**] [**50**] percent available phosphoric acid.
- B. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  - 1. Composition: [**1 lb/1000 sq. ft. (0.5 kg/100 sq. m)**] <Insert value> of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
  - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- C. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  - 1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
  - 2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.
- D. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Place planting soil and fertilizers according to requirements in other Specification Sections.

- B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.
- C. Proceed with placement only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of [**6 inches (150 mm)**] <Insert dimension> and stockpile until amended.
- B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
- C. Unsuitable Materials: Clean soil to contain a maximum of [**8**] <Insert number> percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
- D. Screening: Pass unamended soil through a [**2-inch (50-mm)**] [**3-inch (75-mm)**] <Insert dimension> sieve to remove large materials.

### 3.3 PLACING AND MIXING PLANTING SOIL OVER EXPOSED SUBGRADE

- A. General: Apply and mix unamended soil with amendments on-site to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Subgrade Preparation: Till subgrade to a minimum depth of [**4 inches (100 mm)**] [**6 inches (150 mm)**] [**8 inches (200 mm)**] [**12 inches (300 mm)**] [**18 inches (450 mm)**] <Insert dimension>. Remove stones larger than [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**] [**3 inches (75 mm)**] <Insert dimension> in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
  - 1. Apply, add soil amendments, and mix approximately half the thickness of unamended soil over prepared, loosened subgrade according to "Mixing" Paragraph below. Mix thoroughly into top [**2 inches (50 mm)**] [**4 inches (100 mm)**] of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth [**of 4 inches (100 mm)**] [**of 6 inches (150 mm)**] [**of 8 inches (200 mm)**] [**of 12 inches (300 mm)**] [**indicated on Drawings**] <Insert dimension>, but not less than required to meet finish grades after mixing with amendments and natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
  - 1. Amendments: Apply soil amendments[, **except compost,**] and fertilizer, if required, evenly on surface, and thoroughly blend them with unamended soil to produce planting soil.
    - a. Mix [**lime**] [**and**] [**sulfur**] with dry soil before mixing fertilizer.
    - b. Mix fertilizer with planting soil no more than seven days before planting.

2. Lifts: Apply and mix unamended soil and amendments in lifts not exceeding [8 inches (200 mm)] [12 inches (300 mm)] <Insert dimension> in loose depth for material compacted by compaction equipment, and not more than [4 inches (100 mm)] [6 inches (150 mm)] in loose depth for material compacted by hand-operated tampers.
  - D. Compaction: Compact each blended lift of planting soil to [75 to 82] <Insert number range> percent of maximum Standard Proctor density according to ASTM D 698 and tested in-place [except where a different compaction value is indicated on Drawings].
  - E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- 3.4 PLACING MANUFACTURED PLANTING SOIL OVER EXPOSED SUBGRADE
- A. General: Apply manufactured soil on-site in its final, blended condition. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
  - B. Subgrade Preparation: Till subgrade to a minimum depth of [4 inches (100 mm)] [6 inches (150 mm)] [8 inches (200 mm)] [12 inches (300 mm)] [18 inches (450 mm)] <Insert dimension>. Remove stones larger than [1-1/2 inches (38 mm)] [2 inches (50 mm)] [3 inches (75 mm)] <Insert dimension> in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
    1. Apply approximately half the thickness of planting soil over prepared, loosened subgrade. Mix thoroughly into top [2 inches (50 mm)] [4 inches (100 mm)] of subgrade. Spread remainder of planting soil.
  - C. Application: Spread planting soil to total depth [of 4 inches (100 mm)] [of 6 inches (150 mm)] [of 8 inches (200 mm)] [of 12 inches (300 mm)] [indicated on Drawings] <Insert dimension>, but not less than required to meet finish grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet.
    1. Lifts: Apply planting soil in lifts not exceeding [8 inches (200 mm)] [12 inches (300 mm)] <Insert dimension> in loose depth for material compacted by compaction equipment, and not more than [4 inches (100 mm)] [6 inches (150 mm)] in loose depth for material compacted by hand-operated tampers.
    - D. Compaction: Compact each lift of planting soil to [75 to 82] <Insert number range> percent of maximum Standard Proctor density according to ASTM D 698 [except where a different compaction value is indicated on Drawings].
    - E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
- 3.5 BLENDING PLANTING SOIL IN PLACE
- A. General: Mix amendments with in-place, unamended soil to produce required planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

- B. Preparation: Till unamended, existing soil in planting areas to a minimum depth of [**of 4 inches (100 mm)**] [**of 6 inches (150 mm)**] [**of 8 inches (200 mm)**] [**of 12 inches (300 mm)**] [**of 18 inches (450 mm)**] [**indicated on Drawings**] <Insert dimension>. Remove stones larger than [**1-1/2 inches (38 mm)**] [**2 inches (50 mm)**] [**3 inches (75 mm)**] <Insert dimension> in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
- C. Mixing: Apply soil amendments[, **except compost,**] and fertilizer, if required, evenly on surface, and thoroughly blend them into full depth of unamended, in-place soil to produce planting soil.
  - 1. Mix [**lime**] [**and**] [**sulfur**] with dry soil before mixing fertilizer.
  - 2. Mix fertilizer with planting soil no more than seven days before planting.
- D. Compaction: Compact blended planting soil to [**75 to 82**] <Insert number range> percent of maximum Standard Proctor density according to ASTM D 698[ **except where a different compaction value is indicated on Drawings**].
- E. Finish Grading: Grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### 3.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply [**compost component of planting-soil mix**] [**4 inches (100 mm) of compost**] [**6 inches (150 mm) of compost**] <Insert depth> to surface of in-place planting soil. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.
- B. Finish Grading: Grade surface to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

### 3.7 LAYERED SOIL ASSEMBLIES

- A. Layered Soil Assembly <Insert designation>:
  - 1. [**Top Layer**] <Insert layer designation>: Planting-soil type <Insert drawing designation>.
  - 2. <Insert layer designation>: Planting-soil type <Insert drawing designation>.

### 3.8 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Perform the following tests[ **and inspections**]:
  - 1. Compaction: Test planting-soil compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each



[1000 sq. ft. (100 sq. m)] [2000 sq. ft. (200 sq. m)] <Insert dimension> of in-place soil or part thereof.

2. <Insert name of test>: <Insert requirement>.
3. <Insert name of inspection>: <Insert requirement>.

- C. Soil will be considered defective if it does not pass tests[ **and inspections**].
- D. Prepare test[ **and inspection**] reports.
- E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

### 3.9 PROTECTION

- A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."
- B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
  1. Storage of construction materials, debris, or excavated material.
  2. Parking vehicles or equipment.
  3. Vehicle traffic.
  4. Foot traffic.
  5. Erection of sheds or structures.
  6. Impoundment of water.
  7. Excavation or other digging unless otherwise indicated.
- C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Architect and replace contaminated planting soil with new planting soil.

### 3.10 CLEANING

- A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
  1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION 329113

## SECTION 329200 - TURF AND GRASSES

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. Section Includes:

1. Seeding.
2. Hydroseeding.
3. Sodding.
4. Plugging.
5. Sprigging.
6. Meadow grasses and wildflowers.
7. Turf renovation.
8. Erosion-control material(s).
9. Grass paving.

- B. Related Requirements:

1. Section 329300 "Plants" for trees, shrubs, ground covers, and other plants as well as border edgings and mow strips.
2. Section 334600 "Subdrainage" for below-grade drainage of landscaped areas.

## 1.3 DEFINITIONS

- A. Finish Grade: Elevation of finished surface of planting soil.
- B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

- C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- D. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See [Section 329113 "Soil Preparation"] [Section 329115 "Soil Preparation (Performance Specification)"] and drawing designations for planting soils.
- E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer.
- B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
  - 1. Certification of each seed mixture for [turfgrass sod] [plugs]. Include identification of source and name and telephone number of supplier.
- C. Product Certificates: For fertilizers, from manufacturer.
- D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf[ and meadows] during a calendar year. Submit before expiration of required maintenance periods.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf[ and meadow] establishment.
  - 1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  - 2. Experience: [Three] [Five] <Insert number> years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's **[field supervisor]** **[personnel assigned to the Work]** shall have certification in **[one of]** **[all of]** the following categories from the Professional Landcare Network:
  - a. Landscape Industry Certified Technician - Exterior.
  - b. Landscape Industry Certified Lawncare Manager.
  - c. Landscape Industry Certified Lawncare Technician.
5. Pesticide Applicator: State licensed, commercial.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.
- B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.
- C. Bulk Materials:
  1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  3. Accompany each delivery of bulk materials with appropriate certificates.

#### 1.9 FIELD CONDITIONS

- A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of **[planting completion]** **[Substantial Completion]** **<Insert starting time>**.
  1. Spring Planting: **<Insert dates>**.
  2. Fall Planting: **<Insert dates>**.
- B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

## PART 2 - PRODUCTS

## 2.1 SEED

- A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Rules for Testing Seeds" for purity and germination tolerances.
- B. Seed Species:
1. Quality: State-certified seed of grass species as listed below for solar exposure.
  2. Quality: Seed of grass species as listed below for solar exposure, with not less than [85] <Insert number> percent germination, not less than [95] <Insert number> percent pure seed, and not more than [0.5] <Insert number> percent weed seed:
  3. Full Sun: Bermudagrass (*Cynodon dactylon*).
  4. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
  5. Sun and Partial Shade: Proportioned by weight as follows:
    - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
    - b. 30 percent chewings red fescue (*Festuca rubra* variety).
    - c. 10 percent perennial ryegrass (*Lolium perenne*).
    - d. 10 percent redtop (*Agrostis alba*).
  6. Shade: Proportioned by weight as follows:
    - a. 50 percent chewings red fescue (*Festuca rubra* variety).
    - b. 35 percent rough bluegrass (*Poa trivialis*).
    - c. 15 percent redtop (*Agrostis alba*).
- C. Grass-Seed Mix: Proprietary seed mix as follows:
1. Products: Subject to compliance with requirements, [provide the following] [provide one of the following] [available products that may be incorporated into the Work include, but are not limited to, the following]:
    - a. <Insert manufacturer's name; product name or designation>.

## 2.2 TURFGRASS SOD

- A. Turfgrass Sod: [Certified] [Approved] [Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects], complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
- B. Turfgrass Species: [Bermudagrass (*Cynodon dactylon*)] [Carpetgrass (*Axonopus affinis*)] [Centipedegrass (*Eremochloa ophiuroides*)] [St. Augustinegrass (*Stenotaphrum secundatum*)] [Zoysiagrass (*Zoysia japonica*)] [Zoysiagrass (*Zoysia matrella*)] <Insert species>.

- C. Turfgrass Species: Sod of grass species as follows, with not less than [85] <Insert number> percent germination, not less than [95] <Insert number> percent pure seed, and not more than [0.5] <Insert number> percent weed seed:
1. Full Sun: Kentucky bluegrass (*Poa pratensis*), a minimum of three cultivars.
  2. Sun and Partial Shade: Proportioned by weight as follows:
    - a. 50 percent Kentucky bluegrass (*Poa pratensis*).
    - b. 30 percent chewings red fescue (*Festuca rubra* variety).
    - c. 10 percent perennial ryegrass (*Lolium perenne*).
    - d. 10 percent redtop (*Agrostis alba*).
  3. Shade: Proportioned by weight as follows:
    - a. 50 percent chewings red fescue (*Festuca rubra* variety).
    - b. 35 percent rough bluegrass (*Poa trivialis*).
    - c. 15 percent redtop (*Agrostis alba*).

### 2.3 PLUGS

- A. Plugs: Turfgrass sod, [Certified] [Approved] [Number 1 Quality/Premium, including limitations on thatch, weeds, diseases, nematodes, and insects], complying with "Specifications for Turfgrass Sod Materials" in TPI's "Guideline Specifications to Turfgrass Sodding." Furnish viable sod of uniform density, color, and texture that is cut into square or round plugs, strongly rooted, and capable of vigorous growth and development when planted; of the following turfgrass species and plug size:
1. Turfgrass Species: [Bermudagrass (*Cynodon dactylon*)] [Carpetgrass (*Axonopus affinis*)] [Centipedegrass (*Eremochloa ophiuroides*)] [St. Augustinegrass (*Stenotaphrum secundatum*)] [Zoysiagrass (*Zoysia japonica*)] [Zoysiagrass (*Zoysia matrella*)] <Insert species>.
  2. Plug Size: [2 inches (50 mm)] [3 inches (75 mm)] [4 inches (100 mm)] <Insert dimension>.

### 2.4 SPRIGS

- A. Sod Sprigs: Healthy living stems, rhizomes, or stolons with a minimum of two nodes and attached roots free of soil, of the following turfgrass species:
1. Turfgrass Species: [Bermudagrass (*Cynodon dactylon*)] [Carpetgrass (*Axonopus affinis*)] [Centipedegrass (*Eremochloa ophiuroides*)] [St. Augustinegrass (*Stenotaphrum secundatum*)] [Zoysiagrass (*Zoysia japonica*)] [Zoysiagrass (*Zoysia matrella*)] <Insert species>.
  2. Turfgrass Species: Creeping bentgrass (*Agrostis palustris*).

### 2.5 MEADOW GRASSES AND WILDFLOWERS

- A. Wildflower Seed: Fresh, clean, and dry new seed, of mixed species as follows:

1. **<Insert mix of wildflower species>**.
- B. Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
  1. **<Insert mix of native-grass species>**.
- C. Wildflower and Native-Grass Seed: Fresh, clean, and dry new seed, of mixed species as follows:
  1. **<Insert mix of wildflower and native-grass species>**.
- D. Seed Carrier: Inert material, sharp clean sand or perlite.

## 2.6 FERTILIZERS

- A. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
  1. Composition: **[1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m)] <Insert value>** of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
  1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
  2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

## 2.7 MULCHES

- A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.
- B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.
- C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.
- D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through **1-inch (25-mm)** sieve; soluble salt content of **[2 to 5] <Insert range or value>** decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
  1. Organic Matter Content: **[50 to 60] <Insert number range>** percent of dry weight.

2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- E. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.
- F. Nonasphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.
- G. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

## 2.8 PESTICIDES

- A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

## 2.9 EROSION-CONTROL MATERIALS

- A. Erosion-Control Blankets: Biodegradable wood excelsior, straw, or coconut-fiber mat enclosed in a photodegradable plastic mesh. Include manufacturer's recommended steel wire staples, **6 inches (150 mm)** long.
- B. Erosion-Control Fiber Mesh: Biodegradable burlap or spun-coir mesh, a minimum of **0.92 lb/sq. yd. (0.5 kg/sq. m)**, with 50 to 65 percent open area. Include manufacturer's recommended steel wire staples, **6 inches (150 mm)** long.
- C. Erosion-Control Mats: Cellular, nonbiodegradable slope-stabilization mats designed to isolate and contain small areas of soil over steeply sloped surface, of **[3-inch (75-mm)] [4-inch (100-mm)] [6-inch (150-mm)]** **<Insert dimension>** nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.10 GRASS-PAVING MATERIALS

- A. Grass Paving: Cellular, nonbiodegradable plastic mats, designed to contain small areas of soil and enhance the ability of turf to support vehicular and pedestrian traffic, of **[1-inch (25-mm)] [1-3/4-inch (45-mm)] [2-inch (50-mm)] [manufacturer's standard]** **<Insert dimension>**



nominal mat thickness. Include manufacturer's recommended anchorage system for slope conditions.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- B. Base Course: Sound crushed stone or gravel complying with [ASTM D 448 for Size No. 8] [Section 312000 "Earth Moving" for base-course material] <Insert requirements>.
- C. Sand: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate.
- D. Proprietary Growing Mix: As submitted and acceptable to Architect.
- E. Sandy Loam Soil Mix: Sound, sharp, washed, natural sand or crushed stone complying with gradation requirements in ASTM C 33/C 33M for fine aggregate blended with planting soil <Insert drawing designation>. Use blend consisting of [1/2 sand and 1/2 planting soil] [2/3 sand and 1/3 planting soil] <Insert proportions>.
- F. Soil for Paving Fill: Planting soil <Insert drawing designation>.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  3. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

### 3.2 PREPARATION

- A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.
  1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
  2. Protect grade stakes set by others until directed to remove them.

- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

### 3.3 TURF AREA PREPARATION

- A. General: Prepare planting area for soil placement and mix planting soil according to [Section 329113 "Soil Preparation."] [Section 329115 "Soil Preparation (Performance Specification)."]
- B. Placing Planting Soil: [Place and mix planting soil in place over exposed subgrade] [Place manufactured planting soil over exposed subgrade] [Blend planting soil in place] <Insert requirement>.
  - 1. Reduce elevation of planting soil to allow for soil thickness of sod.
- C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

### 3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

- A. Prepare area as specified in "Turf Area Preparation" Article.
- B. For erosion-control mats, install planting soil in two lifts, with second lift equal to thickness of erosion-control mats. Install erosion-control mat and fasten as recommended by material manufacturer.
- C. Fill cells of erosion-control mat with planting soil and compact before planting.
- D. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

### 3.5 PREPARATION FOR GRASS-PAVING MATERIALS

- A. Reduce subgrade elevation soil to allow for thickness of grass-paving system. Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade so that installed paving is within plus or minus 1/2 inch (13 mm) of finish elevation. Roll and rake, remove ridges, and fill depressions.
- B. Install [base course] [and] [sand course] and [sandy loam soil mix] [proprietary growing mix] [soil for paving fill] as recommended by paving-material manufacturer for site conditions and according to details indicated on Drawings. Compact according to paving-material manufacturer's written instructions.

- C. Install paving mat and fasten according to paving-material manufacturer's written instructions.
- D. Before planting, fill cells of paving mat with [**planting soil**] [**sandy loam soil mix**] [**proprietary growing mix**] [**sand half full**] and compact according to manufacturer's written instructions.
- E. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

### 3.6 SEEDING

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds **5 mph (8 km/h)**.
  - 1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
  - 2. Do not use wet seed or seed that is moldy or otherwise damaged.
  - 3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.
- B. Sow seed at a total rate of [**2 lb/1000 sq. ft. (0.9 kg/92.9 sq. m)**] [**3 to 4 lb/1000 sq. ft. (1.4 to 1.8 kg/92.9 sq. m)**] [**5 to 8 lb/1000 sq. ft. (2.3 to 3.6 kg/92.9 sq. m)**] <Insert values>.
- C. Rake seed lightly into top **1/8 inch (3 mm)** of soil, roll lightly, and water with fine spray.
- D. Protect seeded areas with slopes exceeding [**1:4 with erosion-control blankets**] [**and**] [**1:6 with erosion-control fiber mesh**] installed and stapled according to manufacturer's written instructions.
- E. Protect seeded areas with erosion-control mats where indicated on Drawings; install and anchor according to manufacturer's written instructions.
- F. Protect seeded areas with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly at a minimum rate of [**2 tons/acre (42 kg/92.9 sq. m)**] <Insert values> to form a continuous blanket [**1-1/2 inches (38 mm)**] <Insert dimension> in loose thickness over seeded areas. Spread by hand, blower, or other suitable equipment.
  - 1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
  - 2. Bond straw mulch by spraying with asphalt emulsion at a rate of [**10 to 13 gal./1000 sq. ft. (38 to 49 L/92.9 sq. m)**] <Insert values>. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.
- G. Protect seeded areas from hot, dry weather or drying winds by applying [**compost mulch**] [**peat mulch**] [**planting soil**] within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of [**3/16 inch (4.8 mm)**] <Insert dimension>, and roll surface smooth.

### 3.7 HYDROSEEDING

- A. Hydroseeding: Mix specified seed, [**commercial fertilizer**] [**slow-release fertilizer**] <Insert type>, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.
1. Mix slurry with [**nonasphaltic**] [**asphalt-emulsion**] [**fiber-mulch manufacturer's recommended**] tackifier.
  2. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than [**1500-lb/acre (15.6-kg/92.9 sq. m)**] <Insert values> dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
  3. Spray-apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than [**500-lb/acre (5.2-kg/92.9 sq. m)**] <Insert values> dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of [**1000 lb/acre (10.4 kg/92.9 sq. m)**] <Insert values>.

### 3.8 SODDING

- A. Lay sod within 24 hours of harvesting[ **unless a suitable preservation method is accepted by Architect prior to delivery time**]. Do not lay sod if dormant or if ground is frozen or muddy.
- B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.
1. Lay sod across slopes exceeding 1:3.
  2. Anchor sod on slopes exceeding 1:6 with wood pegs[ **or steel staples**] spaced as recommended by sod manufacturer but not less than two anchors per sod strip to prevent slippage.
- C. Saturate sod with fine water spray within two hours of planting. During first week after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of **1-1/2 inches (38 mm)** below sod.

### 3.9 PLUGGING

- A. Plant plugs in holes or furrows, spaced [**12 inches (300 mm)**] [**18 inches (450 mm)**] <Insert dimension> apart in [**both directions**] [**triangular pattern**]. On slopes, contour furrows to near level.

## 3.10 SPRIGGING

- A. Plant freshly shredded sod sprigs in furrows [**1 to 1-1/2 inches (25 to 38 mm)**] [**1-1/2 to 2 inches (38 to 50 mm)**] [**2-1/2 to 3 inches (64 to 75 mm)**] deep. Place individual sprigs with roots and portions of stem in moistened soil, [**6 inches (150 mm)**] [**12 inches (300 mm)**] **<Insert dimension>** apart in rows [**10 inches (250 mm)**] [**18 inches (450 mm)**] **<Insert dimension>** apart, and fill furrows without covering growing tips. Lightly roll and firm soil around sprigs after planting.
- B. Broadcast sprigs uniformly over prepared surface at a rate of [**10 cu. ft./1000 sq. ft. (0.28 cu. m/92.9 sq. m)**] **<Insert values>** and mechanically force sprigs into lightly moistened soil.
1. Spread a **1/4-inch- (6-mm-)** thick layer of [**compost mulch**] [**peat mulch**] [**planting soil**] on sprigs.
  2. Lightly roll and firm soil around sprigs after planting.
  3. Water sprigs immediately after planting and keep moist by frequent watering until well rooted.

## 3.11 TURF RENOVATION

- A. Renovate existing turf where indicated.
- B. Renovate turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles.
1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
  2. Install new planting soil as required.
- C. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.
- D. Remove topsoil containing foreign materials, such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.
- E. Mow, dethatch, core aerate, and rake existing turf.
- F. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.
- G. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Owner's property.
- H. Till stripped, bare, and compacted areas thoroughly to a soil depth of **6 inches (150 mm)**.
- I. Apply [**soil amendments and**] initial fertilizer required for establishing new turf and mix thoroughly into top **4 inches (100 mm)** of existing soil. Install new planting soil to fill low spots and meet finish grades.
1. Soil Amendment(s): **<Insert required soil amendment(s)>** according to requirements of [**Section 329113 "Soil Preparation."**] [**Section 329115 "Soil Preparation**

(Performance Specification)."] Apply <Insert soil amendment> at the rate of <Insert application rate>.

2. Initial Fertilizer: [Commercial fertilizer] [Slow-release fertilizer] <Insert type> applied according to manufacturer's recommendations.

J. Apply [seed and protect with straw mulch] [sod] [plugs] [sprigs] as required for new turf.

K. Water newly planted areas and keep moist until new turf is established.

### 3.12 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow [bentgrass] <Insert grass species> to a height of 1/2 inch (13 mm) or less.
2. Mow [bermudagrass] <Insert grass species> to a height of 1/2 to 1 inch (13 to 25 mm).
3. Mow [carpetgrass] [centipedegrass] [perennial ryegrass] [zoysiagrass] <Insert grass species> to a height of 1 to 2 inches (25 to 50 mm).
4. Mow [Kentucky bluegrass] [buffalograss] [annual ryegrass] [chewings red fescue] <Insert grass species> to a height of 1-1/2 to 2 inches (38 to 50 mm).
5. Mow [bahiagrass] [turf-type tall fescue] [St. Augustinegrass] <Insert grass species> to a height of 2 to 3 inches (50 to 75 mm).

D. Turf Postfertilization: Apply [commercial fertilizer] [slow-release fertilizer] <Insert type> after initial mowing and when grass is dry.

1. Use fertilizer that provides actual nitrogen of at least [**1 lb/1000 sq. ft. (0.45 kg/92.9 sq. m)**] <Insert value> to turf area.

### 3.13 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding [**90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 5 by 5 inches (125 by 125 mm)**] <Insert coverage>.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.
3. Satisfactory Plugged Turf: At end of maintenance period, the required number of plugs has been established as well-rooted, viable patches of grass, and areas between plugs are free of weeds and other undesirable vegetation.
4. Satisfactory Sprigged Turf: At end of maintenance period, the required number of sprigs has been established as well-rooted, viable plants, and areas between sprigs are free of weeds and other undesirable vegetation.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

### 3.14 MEADOW

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds **5 mph (8 km/h)**.

1. Before sowing, mix seed with seed carrier at a ratio of not less than [**two**] [**three**] [**four**] <Insert number> parts seed carrier to one part seed.
2. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
3. Do not use wet seed or seed that is moldy or otherwise damaged.

B. Sow seed at a total rate of [**4 oz./1000 sq. ft. (113 g/92.9 sq. m)**] [**5 oz./1000 sq. ft. (142 g/92.9 sq. m)**] [**6 oz./1000 sq. ft. (170 g/92.9 sq. m)**] <Insert values>.

C. Brush seed into top **1/16 inch (1.6 mm)** of soil, roll lightly, and water with fine spray.

D. Protect seeded areas from hot, dry weather or drying winds by applying [**peat**] [**or**] [**compost**] mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of **3/16 inch (4.8 mm)**, and roll surface smooth.

E. Water newly planted areas and keep moist until meadow is established.

### 3.15 MEADOW MAINTENANCE

- A. Maintain and establish meadow by watering, weeding, mowing, trimming, replanting, and performing other operations as required to establish a healthy, viable meadow. Roll, regrade, and replant bare or eroded areas and remulch. Provide materials and installation the same as those used in the original installation.
  - 1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and meadow damaged or lost in areas of subsidence.
  - 2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
  - 3. Apply treatments as required to keep meadow and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.
- B. Watering: Install and maintain temporary piping, hoses, and meadow-watering equipment to convey water from sources and to keep meadow uniformly moist.
  - 1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
  - 2. Water meadow with fine spray at a minimum rate of **1/2 inch (13 mm)** per week for **[four] [six] [eight]** weeks after planting unless rainfall precipitation is adequate.

### 3.16 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.17 CLEANUP AND PROTECTION

- A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.
- C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.
- D. Remove nondegradable erosion-control measures after grass establishment period.



## 3.18 MAINTENANCE SERVICE

- A. Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Turf Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:
1. Seeded Turf: [60] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.
    - a. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season.
  2. Sodded Turf: [30] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.
  3. Plugged Turf: [30] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.
  4. Sprigged Turf: [30] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.
- B. Meadow Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in "Meadow Maintenance" Article. Begin maintenance immediately after each area is planted and continue until acceptable meadow is established, but for not less than maintenance period below.
1. Maintenance Period: [40] <Insert number> days from date of [planting completion] [Substantial Completion] <Insert starting time>.

END OF SECTION 329200

## SECTION 329300 - PLANTS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

## A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Tree-watering devices.
4. Landscape edgings.
5. Tree grates.

## B. Related Requirements:

1. Section 015639 "Temporary Tree and Plant Protection" for protecting, trimming, pruning, repairing, and replacing existing trees to remain that interfere with, or are affected by, execution of the Work.
2. Section 129200 "Interior Planters and Artificial Plants" for planters for live and artificial interior plants.
3. Section 329200 "Turf and Grasses" for turf (lawn) and meadow planting, hydroseeding, and erosion-control materials.
4. Section 329600 "Transplanting" for transplanting non-nursery-grown trees.

## 1.3 ALLOWANCES

- A. Allowances for plants are specified in Section 012100 "Allowances."

1. Perform planting work under quantity allowances and only as authorized. Authorized work includes [**work required by Drawings and the Specifications and**] [**only**] work authorized in writing by Architect.

2. Notify Architect [**weekly**] <Insert time interval> of extent of work performed that is attributable to quantity allowances.
  3. Perform work that exceeds quantity allowances only as authorized by Change Orders.
- B. Furnish trees as part of tree allowance.
- C. Furnish <Insert plant variety> as part of <Insert name of allowance>.

#### 1.4 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
- B. Unit prices apply to authorized work covered by quantity allowances.
- C. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

#### 1.5 DEFINITIONS

- A. Backfill: The earth used to replace or the act of replacing earth in an excavation.
- B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than [sizes indicated] [**diameter and depth recommended by ANSI Z60.1 for type and size of plant required**]; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.
- C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than [sizes indicated] [**diameter and depth recommended by ANSI Z60.1 for type and size of plant required**].
- D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.
- E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.
- F. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.
- G. Finish Grade: Elevation of finished surface of planting soil.
- H. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.

- I. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.
- J. Planting Area: Areas to be planted.
- K. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See [Section 329113 "Soil Preparation"] [Section 329115 "Soil Preparation (Performance Specification)"] for drawing designations for planting soils.
- L. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.
- M. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.
- N. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.
- O. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

## 1.6 COORDINATION

- A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.
  - 1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

## 1.7 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [Project site] <Insert location>.

## 1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
  - 2. Plant Photographs: Include color photographs in [digital] [3- by 5-inch (76- by 127-mm) print] format of each required species and size of plant material as it will be furnished to Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than [20] <Insert number> plants are required, include a minimum of [three] <Insert number> photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

- B. Samples for Verification: For each of the following:
1. Trees and Shrubs: [**Three**] <Insert number> Samples of each variety and size[ **delivered to site for review**]. Maintain approved Samples on-site as a standard for comparison.
  2. [**Organic**] [**Compost**] Mulch: [**1-pint (0.5-L)**] [**1-quart (1-L)**] <Insert value> volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.
  3. Mineral Mulch: [**2 lb (1.0 kg)**] [**5 lb (2.5 kg)**] <Insert value> of each mineral mulch required, in sealed plastic bags labeled with source of mulch. Sample shall be typical of the lot of material to be delivered and installed on-site; provide an accurate indication of color, texture, and makeup of the material.
  4. Weed Control Barrier: **12 by 12 inches (300 by 300 mm)**.
  5. Proprietary Root-Ball-Stabilization Device: One unit.
  6. Slow-Release, Tree-Watering Device: One unit of each size required.
  7. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
  8. Tree Grates[, **Frames,**] and Accessories: Manufacturer's standard size[ **delivered to site for review**], to verify design[ **and color**] selected.
  9. Root Barrier: Width of panel by **12 inches (300 mm)**.

#### 1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.
- B. Product Certificates: For each type of manufactured product, from manufacturer, and complying with the following:
1. Manufacturer's certified analysis of standard products.
  2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.
- C. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
- D. Sample Warranty: For special warranty.

#### 1.10 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

## 1.11 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
  2. Experience: [**Three**] [**Five**] <Insert number> years' experience in landscape installation in addition to requirements in Section 014000 "Quality Requirements."
  3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
  4. Personnel Certifications: Installer's [**field supervisor**] [**personnel assigned to the Work**] shall have certification in [**one**] [**all**] of the following categories from the Professional Landcare Network:
    - a. Landscape Industry Certified Technician - Exterior.
    - b. Landscape Industry Certified Interior.
    - c. Landscape Industry Certified Horticultural Technician.
  5. Pesticide Applicator: State licensed, commercial.
- B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.
1. Selection of plants purchased under allowances is made by Architect, who tags plants at their place of growth before they are prepared for transplanting.
- C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements **6 inches (150 mm)** above the root flare for trees up to **4-inch (100-mm)** caliper size, and **12 inches (300 mm)** above the root flare for larger sizes.
  2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.
1. Notify Architect of sources of planting materials [**seven**] <Insert number> days in advance of delivery to site.

## 1.12 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.
- B. Bulk Materials:
  - 1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
  - 2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
  - 3. Accompany each delivery of bulk materials with appropriate certificates.
- C. Deliver bare-root stock plants within **[24 hours]** **[36 hours]** <Insert time> of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.
- D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
- E. Handle planting stock by root ball.
- F. Store bulbs, corms, and tubers in a dry place at **60 to 65 deg F (16 to 18 deg C)** until planting.
- G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.
  - 1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.
- H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.
- I. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.
  - 1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
  - 2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
  - 3. Do not remove container-grown stock from containers before time of planting.

4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

#### 1.13 FIELD CONDITIONS

- A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.
- B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.
  1. Spring Planting: **<Insert dates>**.
  2. Fall Planting: **<Insert dates>**.
- C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

#### 1.14 WARRANTY

- A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
    - b. Structural failures including plantings falling or blowing over.
    - c. Faulty performance of **[tree stabilization] [edgings] [and] [tree grates] <Insert item>**.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
  2. Warranty Periods: From date of **[planting completion] [Substantial Completion] <Insert starting time>**.
    - a. Trees, Shrubs, Vines, and Ornamental Grasses: **[12] <Insert number>** months.
    - b. Ground Covers, Biennials, Perennials, and Other Plants: **[12] [Nine] [Six] [Three] <Insert number>** months.
    - c. Annuals: **[Three] [Two] <Insert number>** months.
  3. Include the following remedial actions as a minimum:
    - a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.



- b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
- c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
- d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

## PART 2 - PRODUCTS

### 2.1 PLANT MATERIAL

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.
  1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than **3/4 inch (19 mm)** in diameter; or with stem girdling roots are unacceptable.
  2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.
- B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.
- C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.
- D. Labeling: Label **[each]** **[at least one]** plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.
- E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.
- F. **[Annuals]** **[and]** **[Biennials]**: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery **[and that are in bud but not yet in bloom]**.

## 2.2 FERTILIZERS

- A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.
1. Size: [**5-gram**] [**10-gram**] [**21-gram**] <Insert size> tablets.
  2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

## 2.3 MULCHES

- A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:
1. Type: [**Shredded hardwood**] [**Ground or shredded bark**] [**Wood and bark chips**] [**Pine straw**] [**Salt hay or threshed straw**] [**Pine needles**] [**Peanut, pecan, and cocoa-bean shells**] <Insert mulch type>.
  2. Size Range: [**3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum**] <Insert dimensions>.
  3. Color: Natural.
- B. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through a **1-inch (25-mm)** sieve; soluble-salt content of [**2 to 5**] <Insert range or value> dS/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:
1. Organic Matter Content: [**50 to 60**] <Insert number range> percent of dry weight.
  2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.
- C. Mineral Mulch: Hard, durable stone, washed free of loam, sand, clay, and other foreign substances, of the following type, size range, and color:
1. Type: [**Rounded riverbed gravel or smooth-faced stone**] [**Crushed stone or gravel**] [**Marble chips**] [**Granite chips**] <Insert stone type>.
  2. Size Range: [**1-1/2 inches (38 mm) maximum, 3/4 inch (19 mm) minimum**] [**3/4 inch (19 mm) maximum, 1/4 inch (6.4 mm) minimum**] <Insert dimensions>.
  3. Color: [**Uniform tan-beige color range acceptable to Architect**] [**Readily available natural gravel color range**] <Insert color>.

## 2.4 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, **3 oz./sq. yd. (101g/sq. m)** minimum, composed of fibers formed into a stable network so that fibers retain their relative position. Fabric shall be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.

- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, **4.8 oz./sq. yd. (162 g/sq. m)**.

## 2.5 PESTICIDES

- A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.
- B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.
- C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

## 2.6 TREE-STABILIZATION MATERIALS

### A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new [**hardwood**] [**softwood with specified wood pressure-preservative treatment**], free of knots, holes, cross grain, and other defects, **2-by-2-inch nominal (38-by-38-mm actual)** by length indicated, pointed at one end.
2. Wood Deadmen: Timbers measuring **8 inches (200 mm)** in diameter and **48 inches (1200 mm)** long, treated with specified wood pressure-preservative treatment.
3. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or [**turnbuckles**] [**compression springs**].
4. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, **0.106 inch (2.7 mm)** in diameter.
5. Tree-Tie Webbing: UV-resistant polypropylene or nylon webbing with brass grommets.
6. Guy Cables: Five-strand, **3/16-inch- (4.8-mm-)** diameter, galvanized-steel cable, with zinc-coated [**turnbuckles**] [**compression springs**], a minimum of **3 inches (75 mm)** long, with two **3/8-inch (10-mm)** galvanized eyebolts.
7. Flags: Standard surveyor's plastic flagging tape, white, **6 inches (150 mm)** long.
8. Proprietary Staking-and-Guying Devices: Proprietary stake or anchor and adjustable tie systems to secure each new planting by plant stem; sized as indicated and according to manufacturer's written recommendations.
  - a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

### B. Root-Ball Stabilization Materials:

1. Upright Stakes and Horizontal Hold-Down: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, **2-by-2-inch nominal (38-by-38-mm actual)** by length indicated; stakes pointed at one end.
2. Wood Screws: ASME B18.6.1.

3. Proprietary Root-Ball Stabilization Devices: Proprietary at- or below-grade stabilization systems to secure each new planting by root ball and that do not encircle the trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

- a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

C. Palm Bracing: Battens or blocks, struts, straps, and protective padding.

1. Battens or Blocks and Struts: Rough-sawn, sound, new hardwood or softwood, free of knots, holes, cross grain, and other defects, **2-by-4-inch nominal (38-by-89-mm actual)** by lengths indicated.
2. Straps: Adjustable steel or plastic package banding.
3. Padding: Burlap.
4. Proprietary Palm-Bracing Devices: Proprietary systems to secure each new planting by trunk; sized according to manufacturer's written recommendations unless otherwise indicated.

- a. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

## 2.7 LANDSCAPE EDGINGS

A. Wood Edging: Of sizes indicated on Drawings, and wood stakes as follows:

1. Species: [**Western red cedar, all heart**] [**Southern pine with specified wood pressure-preservative treatment**].
2. Stakes: Same species as edging, **1-by-2-inch nominal (19-by-38-mm actual)** by **18 inches (450 mm)** long, with galvanized nails for anchoring edging.

B. Steel Edging: Standard commercial-steel edging, fabricated in sections of standard lengths, with loops stamped from or welded to face of sections to receive stakes.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Edging Size: [**3/16 inch (4.8 mm) thick by 4 inches (100 mm) deep**] [**1/4 inch (6.4 mm) thick by 5 inches (125 mm) deep**] [**1/4 inch (6.4 mm) thick by 4 inches (100 mm) deep**] [**1/8 inch (3.2 mm) thick by 4 inches (100 mm) deep**] [**1/8 inch (3.2 mm) thick by 6 inches (150 mm) deep**] [**0.1 inch (2.5 mm) thick by 4 inches (100 mm) deep**] **<Insert dimensions>**.
3. Stakes: Tapered steel, a minimum of [**12 inches (300 mm)**] [**15 inches (380 mm)**] **<Insert dimension>** long.
4. Accessories: Standard tapered ends, corners, and splicers.
5. Finish: [**Manufacturer's standard paint**] [**Zinc coated**] [**Unfinished**].

- a. Paint Color: [**Black**] [**Green**] [**Brown**].

C. Aluminum Edging: Standard-profile extruded-aluminum edging, **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T6, fabricated in standard lengths with interlocking sections with loops stamped from face of sections to receive stakes.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Edging Size: [**3/16 inch (4.8 mm) thick by 5-1/2 inches (140 mm) deep**] [**3/16 inch (4.8 mm) thick by 4 inches (100 mm) deep**] [**1/8 inch (3.2 mm) thick by 5-1/2 inches (140 mm) deep**] [**1/8 inch (3.2 mm) thick by 4 inches (100 mm) deep**] <Insert dimensions>.
3. Stakes: Aluminum, **ASTM B 221 (ASTM B 221M)**, Alloy 6061-T6, approximately **1-1/2 inches (38 mm)** wide by **12 inches (300 mm)** long.
4. Finish: [**Manufacturer's standard paint**] [**Powder-coat paint**] [**Mill (natural aluminum)**] [**Black anodized**].
  - a. Paint Color: [**Black**] [**Green**] [**Brown**].

D. Plastic Edging: Standard black polyethylene or vinyl edging, [**V-lipped bottom**] [**horizontally grooved**] <Insert configuration>, extruded in standard lengths, with **9-inch (225-mm)** [**steel angle**] [**plastic**] stakes.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Edging Size: [**0.1 inch (2.5 mm) thick by 5 inches (125 mm) deep**] [**0.07 inch (1.8 mm) thick by 5 inches (125 mm) deep**] <Insert dimensions>.
3. Top Profile: Straight, with top **2 inches (50 mm)** being **1/4 inch (6.4 mm)** thick.
4. Top Profile: Round top, [**1/2 inch (13 mm)**] [**1 inch (25 mm)**] in diameter.
5. Accessories: Manufacturer's standard alignment clips or plugs.

## 2.8 TREE GRATES

A. Tree Grates: Manufacturer's [**standard**] [**custom designed**] tree grates[ **and frames**].

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Grates: ASTM A 48/A 48M, **Class 35 (Class 250)** or better, gray-iron castings.
3. Frames: [**ASTM A 48/A 48M, Class 35 (Class 250) or better, gray-iron castings**] [**or**] [**ASTM A 36/A 36M steel-angle, hot-dip galvanized,**] of shape, pattern, and size indicated.

B. Shape and Size: [**As indicated on Drawings**] [**Round, 36 inches (914 mm) in diameter**] [**Round, 72 inches (1828 mm) in diameter**] [**48 inches (1219 mm) square**] [**60 inches (1524 mm) square**] [**Rectangular, 36 by 60 inches (914 by 1524 mm)**] [**Rectangular, 48 by 72 inches (1219 by 1828 mm)**] <Insert shape and dimensions>.

C. Finish: [**As fabricated**] [**Powder-coat finish**] <Insert finish>.

1. Color: Low-gloss [**black**] [**dark brown**] [**dark green**] [**dark gray**] <Insert color>.

## 2.9 TREE-WATERING DEVICES

A. Watering Pipe: PVC pipe **4 inches (100 mm)** in diameter, site-cut to length as required, and with snug-fitting removable cap.

B. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over [**an extended time period**] [**two to nine hours**] [**two to three**]

weeks] <Insert number or range>; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
2. Color: [As selected by Architect from manufacturer's full range] [black] [dark chocolate] [green] [or] [tan] <Insert color>.

## 2.10 MISCELLANEOUS PRODUCTS

- A. Wood Pressure-Preservative Treatment: AWWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.
- B. Root Barrier: Black, molded, modular panels [18 inches (457 mm)] [24 inches (610 mm)] <Insert dimension> high (deep), 85 mils (2.2 mm) thick, and with vertical root deflecting ribs protruding 3/4 inch (19 mm) out from panel surface; manufactured with minimum 50 percent recycled polyethylene plastic with UV inhibitors.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
- C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer's written instructions.
- D. Burlap: Non-synthetic, biodegradable.
- E. Planter Drainage Gravel: Washed, sound crushed stone or gravel complying with [ASTM D 448 for Size No. 8] <Insert requirements>.
- F. Planter Filter Fabric: [Woven] [Nonwoven] geotextile manufactured for separation applications and made of polypropylene, polyolefin, or polyester fibers or combination of them.
- G. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
  1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
  2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.

3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
  4. Uniformly moisten excessively dry soil that is not workable or which is dusty.
- B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.
- B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before excavating or planting. Make minor adjustments as required.
- D. Lay out plants at locations directed by Architect. Stake locations of individual trees and shrubs and outline areas for multiple plantings.

### 3.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil according to **[Section 329113 "Soil Preparation.]" [Section 329115 "Soil Preparation (Performance Specification)."]**
- B. Placing Planting Soil: **[Place and mix planting soil in-place over exposed subgrade] [Place manufactured planting soil over exposed subgrade] [Blend planting soil in place] <Insert requirement>**.
- C. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.
- D. Application of Mycorrhizal Fungi: At time directed by Architect, broadcast dry product uniformly over prepared soil at application rate **[indicated on Drawings] [according to manufacturer's written recommendations] <Insert application rate>**.

### 3.4 EXCAVATION FOR TREES AND SHRUBS

- A. Planting Pits and Trenches: Excavate circular planting pits.
1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further

- disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
2. Excavate approximately three times as wide as ball diameter for **[balled and burlapped]** **[balled and potted]** **[container-grown]** **[fabric bag-grown]** stock.
  3. Excavate at least **12 inches (300 mm)** wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
  4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
  5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
  6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
  7. Maintain supervision of excavations during working hours.
  8. Keep excavations covered or otherwise protected **[overnight]** **[after working hours]** **[when unattended by Installer's personnel]**.
  9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.
- B. Backfill Soil: Subsoil and topsoil removed from excavations **[may]** **[may not]** be used as backfill soil unless otherwise indicated.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
1. Hardpan Layer: Drill **6-inch- (150-mm-)** diameter holes, **24 inches (600 mm)** apart, into free-draining strata or to a depth of **10 feet (3 m)**, whichever is less, and backfill with free-draining material.
- D. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
- E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.
- ### 3.5 TREE, SHRUB, AND VINE PLANTING
- A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.
- B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
- C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare **[1 inch (25 mm) above]** **[2 inches (50 mm) above]** **<Insert requirement>** adjacent finish grades.
1. Backfill: Planting soil **<Insert drawing designation>**. **[ For trees, use excavated soil for backfill.]**



2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about **1 inch (25 mm)** from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: **[As indicated on Drawings] [Two per plant] [Three for each caliper inch of plant] <Insert requirement>**.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- D. **[Balled and Potted] [and] [Container-Grown] Stock:** Set each plant plumb and in center of planting pit or trench with root flare [**1 inch (25 mm) above**] [**2 inches (50 mm) above**] **<Insert requirement>** adjacent finish grades.
1. Backfill: Planting soil **<Insert drawing designation>**.**[ For trees, use excavated soil for backfill.]**
  2. Carefully remove root ball from container without damaging root ball or plant.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about **1 inch (25 mm)** from root tips; do not place tablets in bottom of the hole.
    - a. Quantity: **[As indicated on Drawings] [Two per plant] [Three for each caliper inch of plant] <Insert requirement>**.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.
- E. **Fabric Bag-Grown Stock:** Set each plant plumb and in center of planting pit or trench with root flare [**1 inch (25 mm) above**] [**2 inches (50 mm) above**] **<Insert requirement>** adjacent finish grades.
1. Backfill: Planting soil **<Insert drawing designation>**.**[ For trees, use excavated soil for backfill.]**
  2. Carefully remove root ball from fabric bag without damaging root ball or plant. Do not use planting stock if root ball is cracked or broken before or during planting operation.
  3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
  4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about **1 inch (25 mm)** from root tips; do not place tablets in bottom of the hole.

- a. Quantity: **[As indicated on Drawings] [Two per plant] [Three for each caliper inch of plant] <Insert requirement>**.
  5. Continue backfilling process. Water again after placing and tamping final layer of soil.
  - F. Bare-Root Stock: Set and support each plant in center of planting pit or trench with root flare **[1 inch (25 mm) above] [2 inches (50 mm) above] <Insert requirement>** adjacent finish grade.
    1. Backfill: Planting soil **<Insert drawing designation>**.**[ For trees, use excavated soil for backfill.]**
    2. Spread roots without tangling or turning toward surface. Plumb before backfilling, and maintain plumb while working.
    3. Carefully work backfill in layers around roots by hand. Bring roots into close contact with the soil.
    4. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
    5. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside soil-covered roots about **1 inch (25 mm)** from root tips; do not place tablets in bottom of the hole or touching the roots.
      - a. Quantity: **[As indicated on Drawings] [Two per plant] [Three for each caliper inch of plant] <Insert requirement>**.
    6. Continue backfilling process. Water again after placing and tamping final layer of soil.
  - G. Watering Pipe: During backfilling, install watering pipe **4 feet (1.25 m)** deep into the planting pit outside the root ball **[as indicated on Drawings] [and] [with top of pipe 1 inch (25 mm) above the mulched surface]**.
  - H. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.
- 3.6 MECHANIZED TREE-SPADE PLANTING
- A. Trees **[shall] [may]** be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.
  - B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.
  - C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.
  - D. Cut exposed roots cleanly during transplanting operations.
  - E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

- F. Where possible, orient the tree in the same direction as in its original location.

### 3.7 TREE, SHRUB, AND VINE PRUNING

- A. Remove only dead, dying, or broken branches. Do not prune for shape.
- B. Prune, thin, and shape trees, shrubs, and vines as directed by Architect.
- C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.
- D. Do not apply pruning paint to wounds.

### 3.8 TREE STABILIZATION

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
  - 1. Upright Staking and Tying: Stake trees of **2- through 5-inch (50- through 125-mm)** caliper. Stake trees of less than **2-inch (50-mm)** caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least **18 inches (450 mm)** below bottom of backfilled excavation and to extend [**to the dimension indicated on Drawings**] [**at least 72 inches (1830 mm)**] [**one-third of trunk height**] **<Insert dimension or requirement>** above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
  - 2. Upright Staking and Tying: Stake trees with two stakes for trees up to **12 feet (3.6 m)** high and **2-1/2 inches (63 mm)** or less in caliper; three stakes for trees less than **14 feet (4.2 m)** high and up to **4 inches (100 mm)** in caliper. Space stakes equally around trees.
  - 3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
  - 4. Support trees with two strands of tie wire, connected to the brass grommets of tree-tie webbing at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
- B. Trunk Stabilization by Staking and Guying: Install trunk stabilization as follows unless otherwise indicated on Drawings. Stake and guy trees more than **14 feet (4.2 m)** in height and more than **3 inches (75 mm)** in caliper unless otherwise indicated.
  - 1. Site-Fabricated, Staking-and-Guying Method: Install no fewer than three guys spaced equally around tree.
    - a. Securely attach guys to stakes **30 inches (760 mm)** long, driven to grade. Adjust spacing to avoid penetrating root balls or root masses. Provide [**turnbuckle**] [**compression spring**] for each guy wire and tighten securely.
    - b. For trees more than [**6 inches (150 mm) in caliper**] **<Insert size>**, anchor guys to wood deadmen buried at least **36 inches (900 mm)** below grade. Provide [**turnbuckle**] [**compression spring**] for each guy wire and tighten securely.

- c. Support trees with bands of flexible ties at contact points with tree trunk and reaching to **[turnbuckle]** **[compression spring]**. Allow enough slack to avoid rigid restraint of tree.
    - d. Support trees with **[guy cable]** **[or]** **[multiple strands of tie wire]**, connected to the brass grommets of tree-tie webbing at contact points with tree trunk and reaching to **[turnbuckle]** **[compression spring]**. Allow enough slack to avoid rigid restraint of tree.
    - e. Attach flags to each guy wire, **30 inches (760 mm)** above finish grade.
    - f. Paint **[turnbuckles]** **[compression springs]** with luminescent white paint.
  2. Proprietary Staking and Guying Device: Install staking and guying system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by the root ball unless otherwise indicated.
  1. Wood Hold-Down Method: Place vertical stakes against side of root ball and drive them into subsoil; place horizontal wood hold-down stake across top of root ball and screw at each end to one of the vertical stakes.
    - a. Install stakes of length required to penetrate at least **[to the dimension indicated on Drawings]** **[18 inches (450 mm)]** <Insert dimension> below bottom of backfilled excavation. Saw stakes off at horizontal stake.
    - b. Install screws through horizontal hold-down and penetrating at least **1 inch (25 mm)** into stakes. Pre-drill holes if necessary to prevent splitting wood.
    - c. Install second set of stakes on other side of root trunk for larger trees.
  2. Proprietary Root-Ball Stabilization Device: Install root-ball stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.
- D. Palm Bracing: Install bracing system at three or more places equally spaced around perimeter of trunk to secure each palm until established unless otherwise indicated.
  1. Site-Fabricated Palm-Bracing Method:
    - a. Place battens over padding and secure battens in place around trunk perimeter with at least two straps, tightened to prevent displacement. Ensure that straps do not contact trunk.
    - b. Place diagonal braces and cut to length. Secure upper ends of diagonal braces with galvanized nails into battens or into nail-attached blocks on battens. Do not drive nails, screws, or other securing devices into palm trunk; do not penetrate palm trunk in any fashion. Secure lower ends of diagonal braces with stakes driven into ground to prevent outward slippage of braces.
  2. Proprietary Palm-Bracing Device: Install palm-bracing system sized and positioned as recommended by manufacturer unless otherwise indicated and according to manufacturer's written instructions.

### 3.9 ROOT-BARRIER INSTALLATION

- A. Install root barrier where trees are planted within [**60 inches (1500 mm)**] [**48 inches (1200 mm)**] **<Insert dimension>** of paving or other hardscape elements, such as walls, curbs, and walkways, unless otherwise indicated on Drawings.
- B. Align root barrier [**vertically**] [**with bottom edge angled at 20 degrees away from the paving or other hardscape element**], and run it linearly along and adjacent to the paving or other hardscape elements to be protected from invasive roots.
- C. Install root barrier continuously for a distance of [**60 inches (1500 mm)**] **<Insert dimension>** in each direction from the tree trunk, for a total distance of [**10 feet (3 m)**] **<Insert dimension>** per tree. If trees are spaced closer, use a single continuous piece of root barrier.
  - 1. Position top of root barrier [**flush with finish grade**] [**1/2 inch (13 mm)**] **above finish grade**] [**according to manufacturer's written recommendations**].
  - 2. Overlap root barrier a minimum of **12 inches (300 mm)** at joints.
  - 3. Do not distort or bend root barrier during construction activities.
  - 4. Do not install root barrier surrounding the root ball of tree.

### 3.10 PLACING SOIL IN PLANTERS

- A. Place a layer of drainage gravel at least **4 inches (100 mm)** thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric [**4 inches (100 mm)**] [**6 inches (150 mm)**] **<Insert dimension>** up on all sides. Duct tape along the entire top edge of the filter fabric, to secure the filter fabric against the sides during the soil-filling process.
- B. Fill planter with planting soil **<Insert drawing designation>**. Place soil in lightly compacted layers to an elevation of **1-1/2 inches (38 mm)** below top of planter, allowing natural settlement.

### 3.11 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines [**9 inches (225 mm) apart**] [**12 inches (300 mm) apart**] [**18 inches (450 mm) apart**] [**24 inches (600 mm) apart**] [**as indicated on Drawings**] in even rows with triangular spacing.
- B. Use planting soil **<Insert drawing designation>** for backfill.
- C. Dig holes large enough to allow spreading of roots.
- D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.
- F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.
- G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

### 3.12 PLANTING AREA MULCHING

- A. Install weed-control barriers before mulching according to manufacturer's written instructions. Completely cover area to be mulched, overlapping edges a minimum of [6 inches (150 mm)] [12 inches (300mm)] and secure seams with galvanized pins.
- B. Mulch backfilled surfaces of planting areas and other areas indicated.
1. Trees[ **and Treelike Shrubs**] in Turf Areas: Apply [organic] [mineral] mulch ring of [2-inch (50-mm)] [3-inch (75-mm)] <Insert dimension> average thickness, with [12-inch (300-mm)] [24-inch (600-mm)] [36-inch (900-mm)] <Insert dimension> radius around trunks or stems. Do not place mulch within [3 inches (75 mm)] [6 inches (150 mm)] <Insert distance> of trunks or stems.
  2. Organic Mulch in Planting Areas: Apply [2-inch (50-mm)] [3-inch (75-mm)] <Insert dimension> average thickness of organic mulch [extending 12 inches (300 mm) beyond edge of individual planting pit or trench] [and] [over whole surface of planting area], and finish level with adjacent finish grades. Do not place mulch within [3 inches (75 mm)] [6 inches (150 mm)] <Insert distance> of trunks or stems.
  3. Mineral Mulch in Planting Areas: Apply [2-inch (50-mm)] [3-inch (75-mm)] <Insert dimension> average thickness of mineral mulch [extending 12 inches (300 mm) beyond edge of individual planting pit or trench] [and] [over whole surface of planting area], and finish level with adjacent finish grades. Do not place mulch within [3 inches (75 mm)] [6 inches (150 mm)] <Insert distance> of trunks or stems.

### 3.13 EDGING INSTALLATION

- A. Wood Edging: Install edging where indicated.[ **Mitre cut joints and connections at a 45-degree angle.**] Fasten each cut joint or connection with two galvanized nails. Anchor with wood stakes spaced up to 36 inches (900 mm) apart, driven at least 1 inch (25 mm) below top elevation of edging. Use two galvanized nails per stake to fasten edging, of length as needed to penetrate both edging and stake and provide 1/2-inch (13-mm) clinch at point. Pre-drill stakes if needed to avoid splitting. Replace stakes that crack or split during installation process.
- B. Steel Edging: Install steel edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately 30 inches (760 mm) apart, driven below top elevation of edging.
- C. Aluminum Edging: Install aluminum edging where indicated according to manufacturer's written instructions. Anchor with aluminum stakes spaced approximately [36 inches (900 mm)] [48 inches (1200 mm)] apart, driven below top elevation of edging.
- D. Plastic Edging: Install plastic edging where indicated according to manufacturer's written instructions. Anchor with steel stakes spaced approximately [36 inches (900 mm)] [48 inches (1200 mm)] apart, driven through upper base grooves or V-lip of edging.
- E. Shovel-Cut Edging: Separate mulched areas from turf areas[, **curbs, and paving**] with a 45-degree, 4- to 6-inch- (100- to 150-mm-) deep, shovel-cut edge[ **as indicated on Drawings**].
- F. Mow-Strip Installation:

1. Excavate for mow strip[ **as indicated on Drawings**].
2. Compact subgrade uniformly beneath mow strip.
3. Apply nonselective, pre-emergent herbicide that inhibits growth of grass and weeds.
4. Install [**wood**] [**steel**] [**aluminum**] [**plastic**] edging, delineating the edge of mow strip.
5. Install weed-control barrier before mulching, covering area of mow strip, and overlapping and pinning edges of barrier at least **6 inches (150 mm)** and according to manufacturer's written instructions.
6. Place indicated thickness of [**organic**] [**mineral**] mulch, fully covering weed barrier.
7. Rake mulch to a uniform surface level with adjacent finish grades.

### 3.14 TREE GRATE INSTALLATION

- A. Tree Grates: Install according to manufacturer's written instructions. Set grate segments flush with adjoining surfaces. Shim from supporting substrate with soil-resistant plastic. Maintain a **3-inch- (75-mm-)** minimum growth radius around base of tree; break away portions of casting, if necessary, according to manufacturer's written instructions.

### 3.15 INSTALLING SLOW-RELEASE WATERING DEVICE

- A. Provide one device for each tree.
- B. Place device on top of the mulch at base of tree stem and fill with water according to manufacturer's written instructions.

### 3.16 PLANT MAINTENANCE

- A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.
- B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.
- C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

### 3.17 PESTICIDE APPLICATION

- A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
- B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

- C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

### 3.18 REPAIR AND REPLACEMENT

- A. General: Repair or replace existing or new trees and other plants 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, if approved.
  - 3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Remove and replace trees that are more than [25] <Insert number> percent dead or in an unhealthy condition[ **before the end of the corrections period**] or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
  - 1. Provide new trees of same size as those being replaced for each tree of [**6 inches (150 mm)**] [**4 inches (100 mm)**] <Insert dimension> or smaller in caliper size.
  - 2. Provide [**one**] [**two**] <Insert number> new tree(s) of [**6-inch (150-mm)**] [**4-inch (100-mm)**] <Insert dimension> caliper size for each tree being replaced that measures more than [**6 inches (150 mm)**] [**4 inches (100 mm)**] in caliper size.
  - 3. Species of Replacement Trees: [**Same species being replaced**] [**Species selected by Architect**] <Insert species>.

### 3.19 CLEANING AND PROTECTION

- A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.
- B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.
- C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
- D. After installation and before [**Substantial Completion**] <Insert time>, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.
- E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.



## 3.20 MAINTENANCE SERVICE

- A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
1. Maintenance Period: [**12**] [**Six**] [**Three**] months from date of [**planting completion**] [**Substantial Completion**] <Insert starting time>.
- B. Maintenance Service for Ground Cover and Other Plants: Provide maintenance by skilled employees of landscape Installer. Maintain as required in "Plant Maintenance" Article. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:
1. Maintenance Period: [**Six**] [**Three**] months from date of [**planting completion**] [**Substantial Completion**] <Insert starting time>.

END OF SECTION 329300

## SECTION 330500 - COMMON WORK RESULTS FOR UTILITIES

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping joining materials.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Sleeves.
  - 5. Identification devices.
  - 6. Grout.
  - 7. Flowable fill.
  - 8. Piped utility demolition.
  - 9. Piping system common requirements.
  - 10. Equipment installation common requirements.
  - 11. Painting.
  - 12. Concrete bases.
  - 13. Metal supports and anchorages.

## 1.3 DEFINITIONS

- A. Exposed Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions.
- B. Concealed Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- C. ABS: Acrylonitrile-butadiene-styrene plastic.

- D. CPVC: Chlorinated polyvinyl chloride plastic.
- E. PE: Polyethylene plastic.
- F. PVC: Polyvinyl chloride plastic.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Dielectric fittings.
  - 2. Identification devices.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

#### 1.6 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Steel Piping Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Comply with ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

#### 1.8 COORDINATION

- A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- B. Coordinate installation of identifying devices after completing covering and painting if devices are applied to surfaces.

- C. Coordinate size and location of concrete bases. Formwork, reinforcement, and concrete requirements are specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place Concrete."].

## PART 2 - PRODUCTS

### 2.1 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness, unless otherwise indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- G. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
  2. CPVC Piping: ASTM F 493.
  3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  4. PVC to ABS Piping Transition: ASTM D 3138.
- H. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

### 2.2 TRANSITION FITTINGS

- A. Transition Fittings, General: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

- B. Transition Couplings **NPS 1-1/2 (DN 40)** and Smaller:
1. Underground Piping: Manufactured piping coupling or specified piping system fitting.
  2. Aboveground Piping: Specified piping system fitting.
- C. AWWA Transition Couplings **NPS 2 (DN 50)** and Larger:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: AWWA C219, metal sleeve-type coupling for underground pressure piping.
- D. Plastic-to-Metal Transition Fittings:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: [CPVC] [CPVC and PVC] [PVC] one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint[ **or threaded**] end.
- E. Plastic-to-Metal Transition Unions:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: MSS SP-107, [CPVC] [CPVC and PVC] [PVC] four-part union. Include brass[ **or stainless-steel**] threaded end, solvent-cement-joint[ **or threaded**] plastic end, rubber O-ring, and union nut.
- F. Flexible Transition Couplings for Underground Nonpressure Drainage Piping:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## 2.3 DIELECTRIC FITTINGS

- A. Dielectric Fittings, General: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Factory fabricated, union, **NPS 2 (DN 50)** and smaller.
    - a. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**250 psig (1725 kPa)**] at **180 deg F (82 deg C)**.
    - b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded ferrous.
- C. Dielectric Flanges:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Factory-fabricated, bolted, companion-flange assembly, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)** and larger.

- a. Pressure Rating: [**150 psig (1035 kPa) minimum**] [**175 psig (1200 kPa) minimum**] [**300 psig (2070 kPa)**].
  - b. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Nonconducting materials for field assembly of companion flanges, **NPS 2-1/2 (DN 65)** and larger.
    - a. Pressure Rating: [**150 psig (1035 kPa) minimum**] **<Insert pressure>**.
    - b. Gasket: Neoprene or phenolic.
    - c. Bolt Sleeves: Phenolic or polyethylene.
    - d. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining, **NPS 3 (DN 80)** and smaller.
    - a. Pressure Rating: **300 psig (2070 kPa)** at **225 deg F (107 deg C)**.
    - b. End Connections: Threaded.
- F. Dielectric Nipples:
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Description: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining.
    - a. Pressure Rating: [**300 psig (2070 kPa) at 225 deg F (107 deg C)**] **<Insert pressure and temperature>**.
    - b. End Connections: Threaded or grooved.
- 2.4 SLEEVES
- A. Mechanical sleeve seals for pipe penetrations are specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
  - B. Galvanized-Steel Sheet Sleeves: **0.0239-inch (0.6-mm)** minimum thickness; round tube closed with welded longitudinal joint.
  - C. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
  - D. Cast-Iron Sleeves: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
  - E. Molded PVC Sleeves: Permanent, with nailing flange for attaching to wooden forms.
  - F. PVC Pipe Sleeves: ASTM D 1785, Schedule 40.

- G. Molded PE Sleeves: Reusable, PE, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

## 2.5 IDENTIFICATION DEVICES

- A. General: Products specified are for applications referenced in other utilities Sections. If more than single type is specified for listed applications, selection is Installer's option.
- B. Equipment Nameplates: Metal permanently fastened to equipment with data engraved or stamped.
  - 1. Data: Manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliances, and essential data.
  - 2. Location: Accessible and visible.
- C. Stencils: Standard stencils prepared with letter sizes complying with recommendations in ASME A13.1. Minimum letter height is **1-1/4 inches (30 mm)** for ducts, and **3/4 inch (20 mm)** for access door signs and similar operational instructions.
  - 1. Material: [**Fiberboard**] [**Brass**].
  - 2. Stencil Paint: Exterior, oil-based, alkyd-gloss black enamel, unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, oil-based, alkyd enamel in colors according to ASME A13.1, unless otherwise indicated.
- D. Snap-on Plastic Pipe Markers: Manufacturer's standard preprinted, semirigid, snap-on type. Include color-coding according to ASME A13.1, unless otherwise indicated.
- E. Pressure-Sensitive Pipe Markers: Manufacturer's standard preprinted, color-coded, pressure-sensitive-vinyl type with permanent adhesive.
- F. Pipes with OD, Including Insulation, Less Than **6 Inches (150 mm)**: Full-band pipe markers, extending 360 degrees around pipe at each location.
- G. Pipes with OD, Including Insulation, **6 Inches (150 mm)** and Larger: Either full-band or strip-type pipe markers, at least three times letter height and of length required for label.
- H. Lettering: Manufacturer's standard preprinted captions as selected by Architect.
- I. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
  - 1. Arrows: Either integrally with piping system service lettering to accommodate both directions of flow, or as separate unit on each pipe marker to indicate direction of flow.
- J. Plastic Tape: Manufacturer's standard color-coded, pressure-sensitive, self-adhesive vinyl tape, at least **3 mils (0.08 mm)** thick.
  - 1. Width: **1-1/2 inches (40 mm)** on pipes with OD, including insulation, less than **6 inches (150 mm)**; **2-1/2 inches (65 mm)** for larger pipes.
  - 2. Color: Comply with ASME A13.1, unless otherwise indicated.

- K. Valve Tags: Stamped or engraved with **1/4-inch (6.4-mm)** letters for piping system abbreviation and **1/2-inch (13-mm)** sequenced numbers. Include **5/32-inch (4-mm)** hole for fastener.
1. Material: **0.032-inch- (0.8-mm-)** thick, [**polished brass**] [**or**] [**aluminum**].
  2. Material: **0.0375-inch- (1-mm-)** thick stainless steel.
  3. Material: **3/32-inch- (2.4-mm-)** thick plastic laminate with 2 black surfaces and a white inner layer.
  4. Material: Valve manufacturer's standard solid plastic.
  5. Size: **1-1/2 inches (40 mm)** in diameter, unless otherwise indicated.
  6. Shape: As indicated for each piping system.
- L. Valve Tag Fasteners: Brass, wire-link or beaded chain; or brass S-hooks.
- M. Engraved Plastic-Laminate Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
1. Engraving: Engraver's standard letter style, of sizes and with terms to match equipment identification.
  2. Thickness: [**1/16 inch (1.6 mm)**] [**1/8 inch (3 mm)**], unless otherwise indicated.
  3. Thickness: **1/16 inch (1.6 mm)**, for units up to **20 sq. in. (130 sq. cm)** or **8 inches (200 mm)** in length, and **1/8 inch (3 mm)** for larger units.
  4. Fasteners: Self-tapping, stainless-steel screws or contact-type permanent adhesive.
- N. Plastic Equipment Markers: Manufacturer's standard laminated plastic, in the following color codes:
1. Green: Cooling equipment and components.
  2. Yellow: Heating equipment and components.
  3. Brown: Energy reclamation equipment and components.
  4. Blue: Equipment and components that do not meet criteria above.
  5. Hazardous Equipment: Use colors and designs recommended by ASME A13.1.
  6. Terminology: Match schedules as closely as possible. Include the following:
    - a. Name and plan number.
    - b. Equipment service.
    - c. Design capacity.
    - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
  7. Size: **2-1/2 by 4 inches (65 by 100 mm)** for control devices, dampers, and valves; **4-1/2 by 6 inches (115 by 150 mm)** for equipment.
- O. Plasticized Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with mat finish suitable for writing.
1. Size: **3-1/4 by 5-5/8 inches (83 by 143 mm)**.
  2. Fasteners: Brass grommets and wire.
  3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.



- P. Lettering and Graphics: Coordinate names, abbreviations, and other designations used in piped utility identification with corresponding designations indicated. Use numbers, letters, and terms indicated for proper identification, operation, and maintenance of piped utility systems and equipment.
1. Multiple Systems: Identify individual system number and service if multiple systems of same name are indicated.

## 2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
1. Characteristics: Post hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## 2.7 FLOWABLE FILL

- A. Description: Low-strength-concrete, flowable-slurry mix.
1. Cement: ASTM C 150, Type I, portland.
  2. Density: [115- to 145-lb/cu. ft. (1840- to 2325-kg/cu. m)] <Insert value>.
  3. Aggregates: ASTM C 33, natural sand, fine and crushed gravel or stone, coarse.
  4. Aggregates: ASTM C 33, natural sand, fine.
  5. Admixture: ASTM C 618, fly-ash mineral.
  6. Water: Comply with ASTM C 94/C 94M.
  7. Strength: [100 to 200 psig (690 to 1380 kPa)] <Insert value> at 28 days.

## PART 3 - EXECUTION

### 3.1 PIPED UTILITY DEMOLITION

- A. Refer to Section 024119 "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piped utility systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  2. Piping to Be Abandoned in Place: Drain piping. Fill abandoned piping with flowable fill, and cap or plug piping with same or compatible piping material.
  3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
  4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make operational.
  5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 DIELECTRIC FITTING APPLICATIONS

- A. Dry Piping Systems: Connect piping of dissimilar metals with the following:
  - 1. **NPS 2 (DN 50)** and Smaller: Dielectric unions.
  - 2. **NPS 2-1/2 to NPS 12 (DN 65 to DN 300)**: Dielectric flanges[ **or dielectric flange kits**].
- B. Wet Piping Systems: Connect piping of dissimilar metals with the following:
  - 1. **NPS 2 (DN 50)** and Smaller: Dielectric [**couplings**] [**couplings or dielectric nipples**] [**nipples**].
  - 2. **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Dielectric nipples.
  - 3. **NPS 2-1/2 to NPS 8 (DN 65 to DN 200)**: Dielectric nipples[ **or dielectric flange kits**].
  - 4. **NPS 10 and NPS 12 (DN 250 and DN 300)**: Dielectric flange kits.

### 3.3 PIPING INSTALLATION

- A. Install piping according to the following requirements and utilities Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on the Coordination Drawings.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Select system components with pressure rating equal to or greater than system operating pressure.
- I. Sleeves are not required for core-drilled holes.
- J. Permanent sleeves are not required for holes formed by removable PE sleeves.
- K. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.
  - a. Exception: Extend sleeves installed in floors of equipment areas or other wet areas [2 inches (50 mm)] <Insert dimension> above finished floor level.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - a. [PVC] [Steel] Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).
  - b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
- L. Verify final equipment locations for roughing-in.
- M. Refer to equipment specifications in other Sections for roughing-in requirements.

### 3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and utilities Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- E. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- G. Grooved Joints: Assemble joints with grooved-end pipe coupling with coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- H. Soldered Joints: Apply ASTM B 813 water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B 32.
- I. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- J. Pressure-Sealed Joints: Assemble joints for plain-end copper tube and mechanical pressure seal fitting with proprietary crimping tool to according to fitting manufacturer's written instructions.
- K. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 appendixes.
  - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
  - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
  - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
  - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- L. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- M. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- N. Plastic Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End PE Pipe and Fittings: Use butt fusion.
  - 2. Plain-End PE Pipe and Socket Fittings: Use socket fusion.
- O. Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Install dielectric fittings at connections of dissimilar metal pipes.

### 3.6 EQUIPMENT INSTALLATION

- A. Install equipment level and plumb, unless otherwise indicated.
- B. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference with other installations. Extend grease fittings to an accessible location.
- C. Install equipment to allow right of way to piping systems installed at required slope.

### 3.7 PAINTING

- A. Painting of piped utility systems, equipment, and components is specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.8 IDENTIFICATION

- A. Piping Systems: Install pipe markers on each system. Include arrows showing normal direction of flow.
  - 1. Stenciled Markers: According to ASME A13.1.
  - 2. Plastic markers, with application systems. Install on insulation segment if required for hot noninsulated piping.
  - 3. Locate pipe markers on exposed piping according to the following:
    - a. Near each valve and control device.
    - b. Near each branch, excluding short takeoffs for equipment and terminal units. Mark each pipe at branch if flow pattern is not obvious.
    - c. Near locations where pipes pass through walls or floors or enter inaccessible enclosures.
    - d. At manholes and similar access points that permit view of concealed piping.
    - e. Near major equipment items and other points of origination and termination.
- B. Equipment: Install engraved plastic-laminate sign or equipment marker on or near each major item of equipment.
  - 1. Lettering Size: Minimum **1/4 inch (6.4 mm)** high for name of unit if viewing distance is less than **24 inches (610 mm)**, **1/2 inch (13 mm)** high for distances up to **72 inches (1800 mm)**, and proportionately larger lettering for greater distances. Provide secondary lettering two-thirds to three-fourths of size of principal lettering.
  - 2. Text of Signs: Provide name of identified unit. Include text to distinguish among multiple units, inform user of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
- C. Adjusting: Relocate identifying devices that become visually blocked by work of this or other Divisions.

### 3.9 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than **4 inches (100 mm)** larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use [**3000-psi (20.7-MPa)**] <Insert strength>, 28-day compressive-strength concrete and reinforcement as specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete."**]

### 3.10 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Section 055000 "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor piped utility materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.11 GROUTING

- A. Mix and install grout for equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 330500

## SECTION 334713 - POND AND RESERVOIR LINERS

**TIPS:**

To view non-printing **Editor's Notes** that provide guidance for editing, click on MasterWorks/Single-File Formatting/Toggle/Editor's Notes.

To read **detailed research, technical information about products and materials, and coordination checklists**, click on MasterWorks/Supporting Information.

## 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 geomembrane liners[ **and floating covers**] for ponds and reservoirs fabricated from the following:
1. Linear low-density polyethylene (LLDPE).
  2. High-density polyethylene (HDPE).
  3. Polypropylene (PP).
  4. Ethylene-propylene-diene monomer (EPDM).
  5. Polyvinyl chloride (PVC).
  6. Ethylene interpolymer alloy (EIA).
  7. Chlorosulfonated polyethylene (CSPE).
- B. Related Requirements:
1. [**Section 033000 "Cast-in-Place Concrete"**] [**Section 033053 "Miscellaneous Cast-in-Place Concrete"**] for perimeter concrete.
  2. Section 221429 "Sump Pumps" for drainage of floating covers.
  3. Section 312000 "Earth Moving" for excavating, compacting, and grading the subgrade; for excavating and backfilling the anchor trench; for protecting the earthwork; for adding requirements for the earth cover; and for the filter fabric and other geotextiles.
  4. Section 312319 "Dewatering" for removing ground water from subgrade to the extent required by liner manufacturer.
  5. Section 334600 "Subdrainage" for drain piping for floating covers.

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, and accessories for geomembrane liners[ **and floating covers**].
- B. Shop Drawings: Include panel layout, seams, penetrations, perimeter anchorage, and methods of attachment and sealing to other construction. Differentiate between factory and field seams and joints.
- C. Samples: For each exposed product and for each color specified. Include one **12-inch (300-mm)** seam length for factory-bonded sheets and one **12-inch (300-mm)** seam length for field-bonded sheets.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of geomembrane liner[ **and floating cover**].
- C. Product Test Reports: For each geomembrane sheet, for tests performed by a qualified testing agency.
- D. Source quality-control reports.
- E. Field quality-control reports.
- F. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For geomembrane liner[ **and floating cover**] to include in maintenance manuals.

#### 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: [**Fabricator of products**] [**An entity that employs installers and supervisors who are trained and approved by manufacturer**].

#### 1.8 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace geomembrane liner[ **and floating cover**] that fail(s) in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:



- a. Leaks in geomembrane liner[ **and floating cover**].
  - b. Defects in seams.
  - c. Cracks and holes in floating cover.
2. Warranty Period: [**One**] [**Five**] [**10**] <Insert number> year(s) from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain geomembrane liner[ **and floating cover**], accessories, and required seaming materials, solvents, and adhesives from single source.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide geomembrane liners[ **and floating covers**] that prevent the passage of water[ **and gas**].

### 2.3 LLDPE SHEET MATERIALS

- A. LLDPE Sheet: Formulated from virgin PE, compounded for use in hydraulic structures, and formed into uniform sheets with material properties complying with [**GRI Test Method GM17, non-reinforced,**] [**GRI Test Method GM25, reinforced,**] for thickness indicated.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Minimum Average Sheet Thickness: [**20 mils (0.50 mm)**] [**30 mils (0.75 mm)**] [**40 mils (1.00 mm)**] [**50 mils (1.25 mm)**] [**60 mils (1.50 mm)**] [**80 mils (2.00 mm)**] [**100 mils (2.50 mm)**] [**120 mils (3.00 mm)**] <Insert dimension> per ASTM D 5199.
  3. Nominal Sheet Thickness: [**24 mils (0.61 mm)**] [**36 mils (0.91 mm)**] [**45 mils (1.10 mm)**] <Insert dimension> per ASTM D 5199.
  4. Sheet Texture: One side smooth; other side [**smooth**] [**textured**].

### 2.4 HDPE SHEET MATERIALS

- A. HDPE Sheet: Formulated from virgin PE, compounded for use in hydraulic structures, and formed into uniform sheets with material properties complying with GRI Test Method GM13 for thickness indicated.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Minimum Average Sheet Thickness: [**30 mils (0.75 mm)**] [**40 mils (1.00 mm)**] [**50 mils (1.25 mm)**] [**60 mils (1.50 mm)**] [**80 mils (2.00 mm)**] [**100 mils (2.50 mm)**] [**120 mils (3.00 mm)**] <Insert dimension> per ASTM D 5199.
  3. Sheet Texture: One side smooth; other side [**smooth**] [**textured**].

## 2.5 PP SHEET MATERIALS

- A. PP Sheet: Formulated from virgin PP, compounded for use in hydraulic structures, and formed into uniform, flexible [**non-reinforced**] [**reinforced**] sheets with material properties complying with GRI Test Method GM18 for thickness indicated.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Minimum Average Sheet Thickness: [**30 mils (0.75 mm)**] [**40 mils (1.00 mm)**] [**60 mils (1.50 mm)**] [**36 mils (0.91 mm)**] [**45 mils (1.10 mm)**] <Insert dimension> per ASTM D 5199.
  3. Reinforcing Scrim: One-ply polyester fabric totally encapsulated between two sheets.
    - a. Construction: [**9 x 9 - 1000 d**] [**10 x 10 - 1000 d**] <Insert value(s)>.
  4. Sheet Texture: One side smooth; other side [**smooth**] [**textured**].

## 2.6 EPDM SHEET MATERIALS

- A. EPDM Sheet: Formulated from EPDM, compounded for use in hydraulic structures and formed into uniform, flexible [**non-reinforced**] [**reinforced**] sheets with material properties complying with GRI Test Method GM21 for nominal thickness indicated.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Minimum Average Sheet Thickness: [**45 mils (1.10 mm)**] [**60 mils (1.50 mm)**] <Insert dimension> per ASTM D 5199.
  3. Reinforcing Scrim: One-ply polyester fabric totally encapsulated between two sheets.
    - a. Construction: [**9 x 9 - 1000 d**] [**10 x 10 - 1000 d**] <Insert value(s)>.

## 2.7 PVC SHEET MATERIALS

- A. PVC Sheet: Formulated from virgin PVC with plasticizers and other modifiers, compounded for use in hydraulic structures, and formed into uniform, flexible non-reinforced sheets with material properties complying with [**ASTM D 7176**] [**PGI 1104, "Specification for PVC Geomembranes,"**] for nominal thickness indicated.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Nominal Thickness: [**10 mils (0.25 mm)**] [**20 mils (0.51 mm)**] [**30 mils (0.76 mm)**] [**40 mils (1.02 mm)**] [**50 mils (1.3 mm)**] [**60 mils (1.5 mm)**].
  3. Sheet Texture: One side smooth; other side [**smooth**] [**matte**] [**faillie textured**].

## 2.8 EIA SHEET MATERIALS

- A. EIA Sheet: Formulated from EIA for use in hydraulic structures and formed into uniform, flexible reinforced sheets.
1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)

2. Reinforcing Scrim: One-ply polyester fabric totally encapsulated between two sheets.
  - a. Construction: [6 x 6 - 1000 d] [8 x 8 - 500 d] [10 x 10 - 1000 d] [10 x 11 - 2520 d x 2000 d] <Insert value(s)>.
3. Nominal Thickness: [36-mil- (0.91-mm-)] <Insert dimension> thick sheet per ASTM D 1593 or ASTM D 751, Optical Method.
4. Tensile Strength: Not less than [400 lbf (1.8 kN)] <Insert value> minimum average per ASTM D 751, Procedure A.
5. Tear Strength: Not less than [35 lbf (0.16 kN)] <Insert value> minimum average per ASTM D 5884 or ASTM D 751, Procedure B.
6. Puncture Resistance: Not less than [150 lbf (0.67 kN)] <Insert value> minimum average per ASTM D 4833.
7. Hydrostatic Resistance: Not less than [100-psi (690-kPa)] <Insert value> minimum average resistance per ASTM D 751, Procedure A.
8. Dimensional Stability, Reinforced Sheet: Not more than plus or minus 2 percent per ASTM D 1204.
9. Low-Temperature Flexibility: Pass, 1/8-inch (3-mm) mandrel, four hours at minus 30 deg F (minus 34 deg C), and per ASTM D 2136.
10. UV-Light Resistance: Pass, 4000 hours at 176 deg F (80 deg C), per ASTM G 155.
11. Ply Adhesion: Not less than [7 lbf/in. (1.2 kN/m)] [10 lbf/in. (1.75 kN/m)] <Insert value> of seam width, or film tearing bond, according to ASTM D 413, Machine Method.

## 2.9 CSPE SHEET MATERIALS

- A. CSPE Sheet: Formulated from CSPE for use in hydraulic structures and formed into uniform, flexible reinforced sheets.
  1. [<Double click here to find, evaluate, and insert list of manufacturers and products.>](#)
  2. Reinforcing Scrim: One-ply polyester fabric totally encapsulated between two sheets.
    - a. Construction: [6 x 6 - 1000 d] [8 x 8 - 250 d] [10 x 10 - 1000 d] <Insert value(s)>.
  3. Water Absorption: Not more than 2 percent at 70 deg F (21 deg C) and not more than 30 percent at 158 deg F (70 deg C) for 30 days each per ASTM D 471, 30-mil- (0.76-mm-) thick sheet.
  4. Nominal Thickness: [45-mil- (1.14-mm-)] <Insert dimension> thick sheet per ASTM D 5199 or ASTM D 751, Optical Method.
  5. Nominal Thickness over Scrim: [11-mil- (0.28-mm-)] <Insert dimension> thick sheet per ASTM D 5199 or ASTM D 751, Optical Method.
  6. Breaking Strength: Not less than [200 lbf (0.89 kN)] <Insert value> minimum average per ASTM D 751, Procedure A.
  7. Tear Strength, Initial: Not less than [70 lbf (0.31 kN)] <Insert value> minimum average per ASTM D 5884 or ASTM D 751, Procedure B.
  8. Tear Strength, after Aging: Not less than [35 lbf (0.16 kN)] <Insert value> minimum average per ASTM D 5884 or ASTM D 751, Procedure B.
  9. Puncture Resistance: Not less than [200 lbf (0.89 kN)] <Insert value> minimum average per ASTM D 4833.

10. Hydrostatic Resistance: Not less than [**250-psi (1725-kPa)**] <Insert value> minimum average resistance per ASTM D 5514, Procedure A or ASTM D 751, Method A, Procedure 1.
11. Dimensional Stability, Reinforced Sheet: Not more than plus or minus 2 percent per ASTM D 1204.
12. Low-Temperature Flexibility: Pass, **1/8-inch (3-mm)** mandrel, four hours at **minus 40 deg F (minus 40 deg C)**, and per ASTM D 2136.
13. UV-Light Resistance: Pass, 4000 hours at **176 deg F (80 deg C)**, per ASTM G 155.
14. Ply Adhesion: Not less than [**7 lbf/in. (1.2 kN/m)**] [**10 lbf/in. (1.75 kN/m)**] <Insert value> of seam width, or film tearing bond, according to ASTM D 413, Machine Method.

## 2.10 FLOATING COVER ACCESSORIES

- A. Screened Scupper Hoses: Manufacturer's standard.
- B. Flotation Blocks: Closed-cell PE foam blocks approximately **4 by 12 inches (102 by 300 mm)**, **2.2 lb/cu. ft. (35.2 kg/cu. m)**.
- C. Access Hatch: Manufacturer's standard, in size indicated.

## 2.11 MISCELLANEOUS MATERIALS

- A. Adhesives: Provide types of adhesive primers, compounds, solvents, and tapes recommended in writing by geomembrane liner manufacturer for bonding to structures (if required), for sealing of seams in geomembrane liner, and for sealing penetrations through geomembrane liner.
- B. Penetration Assemblies: Provide manufacturer's standard factory-fabricated assemblies for sealing penetrations. Include joint sealant recommended in writing by geomembrane liner manufacturer and compatible with geomembrane liner, containment conditions, and materials.
- C. Battens: Long-length strips of material indicated, size as indicated on Drawings. Fabricate battens with sharp projections removed and edges eased and then predrilled or punched for anchors. Provide anchors, or other type of attachment, of type and spacing recommended in writing by geomembrane liner manufacturer for attaching geomembrane liner system to substrate and as indicated.
  1. Batten Material: Liner manufacturer's standard system.
  2. Batten Material: Aluminum; with stainless-steel anchors, complete with gasket and sealant compatible with geomembrane liner, containment conditions, and materials.
  3. Batten Material: Stainless steel; with stainless-steel anchors, complete with gasket and sealant compatible with geomembrane liner, containment conditions, and materials.
  4. Batten Material: Plastic compatible with geomembrane liner, cast in place or fastened with stainless-steel anchors, designed to continuously seal geomembrane liner to batten.
- D. Sand: ASTM C 33/C 33M; fine aggregate, natural or manufactured sand.

## 2.12 FABRICATION

- A. Fabricate geomembrane liner[ **and floating cover**] panels from sheets in sizes as large as possible with factory-sealed seams, consistent with limitations of weight and installation procedures. Minimize field seaming.
- B. Fabricate flotation blocks, wrap in geomembrane sheet, and attach to underside of floating cover according to manufacturer's written instructions.
- C. Fabricate ballast tubes of sand-filled geomembrane sheet and attach to top surface of floating cover according to manufacturer's written instructions.
- D. Install built-in accessories, hatches, access panels, vents, and walkways on geomembrane floating cover.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for soil compaction and grading; for subgrade free from angular rocks, rubble, roots, vegetation, debris, voids, protrusions, and ground water; and for other conditions affecting performance of geomembrane liner.
- B. Examine anchor [**trench excavation**] [**concrete perimeter**], where geomembrane liner[ **and floating cover**] will be secured, for substrate conditions indicated above and for correct location and configuration.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary ballast, until edges are permanently secured, that does not damage geomembrane liner or substrate, to prevent uplift of geomembrane liner in areas with prevailing winds.
- B. Prepare surfaces of construction penetrating through geomembrane liner according to geomembrane liner manufacturer's written instructions.
- C. Remove curing compounds and coatings from concrete surfaces to be sealed to geomembrane liner.

### 3.3 INSTALLATION

- A. General: Place geomembrane liner over prepared surfaces to ensure minimum handling. Install according to Shop Drawings and in compliance with geomembrane liner manufacturer's written instructions. Begin placing geomembrane liner at Project's upwind direction and proceed downwind. Install geomembrane liner in a relaxed condition, free from stress and with

minimum wrinkles, and in full contact with subgrade. Do not bridge over voids or low areas in the subgrade. Fit closely and seal around inlets, outlets, and other projections through geomembrane liner. Permanently secure edges.

- B. Field Seams: Comply with geomembrane liner[ **and floating cover**] manufacturer's written instructions. Form seams by lapping edges of panels **2 to 4 inches (50 to 102 mm)**, unless instructions require a larger overlap. Wipe contact surfaces clean and free of dirt, dust, moisture, and other foreign materials. Use solvent-cleaning methods and grind geomembrane seam surfaces if recommended by geomembrane liner manufacturer. Proceed with seaming at required temperatures for materials and ambient conditions. Continuously bond sheet to sheet to construct single or double seams of width recommended for method of seaming used. Seal or fuse free seam edges. Inspect seams and reseal voids.
1. Adhesive Bonding: Apply bonding cement to both contact surfaces in seam area and press together immediately, or use other seaming methods as instructed by geomembrane liner manufacturer. Roll to press surfaces together, to distribute adhesive to leading edges of panels, and to remove wrinkles and fishmouths. Remove excess adhesive.
  2. Thermal Bonding: Use thermal-welding technique recommended by geomembrane liner manufacturer. Apply pressure to smoothly bond surfaces together. Examine for and patch wrinkles and fishmouths.
- C. Installation in Anchor Trench: Install geomembrane liner[ **and floating cover**] in trench according to manufacturer's written instructions. Backfill and compact to lock liner into trench.
- D. Attachment to Concrete: Use manufacturer's standard system to suit Project conditions. Support adhesive and geomembrane on minimum **8-inch- (200-mm-)** wide concrete substrate unless otherwise indicated.
1. Install batten strips over geomembrane liner[ **and floating cover**] as indicated on Drawings.
  2. Install antichafing strips of geomembrane sheet between geomembrane liner and floating cover according to manufacturer's written instructions.
  3. Install floating cover with perimeter fold.
- E. Floating Cover Flotation Control: Connect drainage hoses in perimeter fold, sumps, or scuppers to pump or gravity drain system.
- F. Liner Repairs: Repair tears, punctures, and other imperfections in geomembrane liner field and seams using patches of geomembrane liner material, liner-to-liner bonding materials, and bonding methods according to geomembrane liner manufacturer's written instructions. Apply bonding solvent or weld to contact surfaces of both patch and geomembrane liner, and press together immediately. Roll to remove wrinkles.

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Nondestructive Testing: Visually inspect seams and patches. Comply with ASTM D 4437 for Air Lance Test, Vacuum Box Testing, or Ultrasonic (High Frequency) Pulse Echo Testing or

with GRI Test Method GM6, as applicable to geomembrane liner[ **and floating cover**] and seam construction. Record locations of failed seams and patches. Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches.

- C. Destructive Testing: Comply with GRI Test Method GM19, as applicable to geomembrane liner[ **and floating cover**] and seam construction. Record locations of sample locations and failed seams. Individually number and date occurrences and details of leak and remedial action. Repair leaking seams and patches, and test sample locations.
- D. Prepare test and inspection reports.

### 3.5 DISINFECTION

- A. Disinfect the complete installation according to procedures in AWWA C652.

### 3.6 PROTECTION

- A. Protect installed geomembrane liner[ **and floating cover**] according to manufacturer's written instructions. Repair or replace areas of geomembrane liner damaged by scuffing, punctures, traffic, rough subgrade, or other unacceptable conditions.
- B. Before initial filling of pond or placement of earth cover, inspect seams and patched areas to ensure tight, continuously bonded installation. Repair damaged geomembrane liner and seams and reinspect repaired work.

END OF SECTION 334713