

MANUAL DE ESPECIFICACIONES TÉCNICAS

PÓRTICO DE LAS ARTES

*REDISEÑO DE LA PLAZOLETA DEL CENTRO DE
BELLAS ARTES LUIS A. FERRÉ*

22 Avenida Ponce de León
San Juan, Puerto Rico

PROFESSIONALS OF RECORD:

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JORGE RIGAU FAIA **ARQUITECTOS PSC**
OCTOBER, 2022

This document contains a total of 898 pages

SECTION 000101 - PROJECT TITLE PAGE

PART 1 - GENERAL

1.1 PROJECT MANUAL

- A. VOLUME PBA
- B. Pórtico de las Artes.
- C. Jetpphet Pérez de Corcho Morgado.
- D. San Juan, Puerto Rico.
- E. Architect Project No. PBA-22.
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- L. Issued: July 30,2022.
- M. Copyright Jorge Rigau Arquitectos PSC. All rights reserved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 000101

DOCUMENT 000107 - SEALS PAGE

PART 1 - GENERAL

1.1 DESIGN PROFESSIONALS OF RECORD

- A. Architect:
 - 1. Jorge Rigau.
 - 2. **#7650.**
 - 3. Responsible for Divisions #01-#33 Sections except where indicated as prepared by other design professionals of record.
- B. Civil Engineer:
 - 1. Frank Collazo.
 - 2. **Lic. #7268.**
 - 3. Responsible for Division #31.
- C. Landscape Architect:
 - 1. Frances de la Rosa.
 - 2. **Lic. #10.**
 - 3. Responsible for Divisions #32.
- D. Structural Engineer:
 - 1. Joaquin De Mari.
 - 2. **Lic. #21268.**
 - 3. Responsible for Divisions #03 & 05.
- E. Plumbing Engineer:
 - 1. Francisco Maté.
 - 2. **Lic. #13947.**
 - 3. Responsible for Division #22.
- F. Electrical Engineer:
 - 1. Carlos Requena.
 - 2. **Lic. #19722.**
 - 3. Responsible for Division #26.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

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PART 1 - GENERAL

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- B. List of Drawings: Drawings consist of the following Contract Drawings and other drawings of type indicated:
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 8. AD-201 / PLANO DE DEMOLICIÓN CORTES A-A, B-B & C-C
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PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF DOCUMENT 000115

SECTION 010000 - GENERAL REQUIREMENTS

PART 1 - GENERAL (Not Used)

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 010000

SECTION 011000 - SUMMARY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased construction.
4. Work performed by Owner.
5. Multiple Work Packages.
6. Work under Owner's separate contracts.
7. Future work not part of this Project.
8. Owner's product purchase contracts.
9. Owner-furnished/Contractor-installed (OFICI) products.
10. Owner-furnished/Owner-installed (OFOI) products.
11. Contractor-furnished/Owner-installed (CFOI) products.
12. Contractor's use of site and premises.
13. Coordination with occupants.
14. Work restrictions.
15. Specification and Drawing conventions.
16. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.
2. Section 017300 "Execution" for coordination of Owner-installed products.

1.2 DEFINITIONS

- A. Work Package:** A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.3 PROJECT INFORMATION

A. Project Identification: **PB-22_Pórtico de Las Artes.**

1. Project Location: **Centro de Bellas Artes Ave. Ponce De León Pda. 22 1/2, San Juan, Puerto Rico 00907.**

B. Owner: **La Corporación del Centro de Bellas Artes.**

1. Owner's Representative: **Jetppeht Pérez de Corcho Morgado.**

C. Architect: **Jorge Rigau Arquitectos PSC.**

1. Architect's Representative: **Alexander Esparolini Hernández, AIA Assoc.**

D. Project Mechanical/Electrical Coordinator for Multiple Contracts:

1. **<Insert name and contact information of mechanical/electrical Project coordinator>** has been engaged by Owner to serve as Project coordinator.

2. **[HVAC Contractor] [Electrical Contractor] [Plumbing Contractor] [Construction**

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, 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 list of multiple contracts, a description of work included under each of the multiple contracts, and the responsibilities of Project coordinator.

1.5 PHASED CONSTRUCTION

A. Construct the Work in phases, with each phase substantially complete as indicated [**on Drawings**] [**below**].

1. Phase **<Insert designation>**: **<Briefly describe work of this phase>**.
 - a. Commencement of Construction:
 - 1) Notice to Proceed: Work of this phase shall commence within **<Insert number of days>** after the Notice to Proceed.
 - 2) Start Date: Work of this phase shall commence by **<Insert date>**.
 - b. Substantial Completion:
 - 1) Within **<Insert number of days>** after [**commencement of construction of this phase**] [**after the Notice to Proceed**].
 - 2) By **<Insert date>**.
2. Phase **<Insert designation>**: Perform the remaining Work. The remaining Work shall be substantially complete at time of Substantial Completion of 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 PERFORMED BY OWNER

A. 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 **MULTIPLE WORK PACKAGES**

- A. Construction Documents for this Project will be issued in a series of Work Packages, each defining the Work under individual Contracts. Coordinate the Work under this Contract with separate contracts defined by other work packages. **[Work Packages consist of the following:]**
 1. **[Early Site Package] <Insert Work Package title>: <Insert description of Work>. To be issued <Insert date of anticipated issue>.**
 2. **[Foundations and Structure Package] <Insert Work Package title>: <Insert description of Work>. To be issued <Insert date of anticipated issue>.**
 3. **[General Building Package] <Insert Work Package title>: <Insert description of Work>. To be issued <Insert date of anticipated issue>.**
 4. **[Interior Upfit Package] <Insert Work Package title>: <Insert description of Work>. To be issued <Insert date of anticipated issue>.**

1.8 **WORK UNDER OWNER'S SEPARATE CONTRACTS**

- A. Work with Separate Contractors: Cooperate fully with Owner's 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 Owner's separate contracts.
- B. Preceding Work: Owner **[has awarded] [or] [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] [may be substantially complete or may be partially conducted simultaneously with Work under this Contract]**.
 1. **<Insert name of the Contract>: To <Insert name of Owner's separate Contractor> [to] [for] <Insert a brief description of work performed under Owner's 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 Owner's separate Contractor> [to] [for] <Insert a brief description of work performed under Owner's 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 Owner's separate Contractor> [to] [for] <Insert a brief description of work performed under Owner's separate contract>.**
- E. Future Work Not Part of this Contract: 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 OWNER'S PRODUCT PURCHASE CONTRACTS

- A. Owner has negotiated Product Purchase contracts with suppliers of material and equipment to be incorporated into the Work. Owner will assign these Product 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 Product Purchase contracts, including responsibility to renegotiate purchase and to execute final purchasing agreements.
- B. Owner's Product 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 of Product Purchase contract firm and representative>**.
 - b. Product Purchase Contract Scope: **[Furnishing material] [Material and installation labor] <Insert description of contract>**.
 - c. Product Purchase Status: **[Price negotiated by Owner, to be incorporated into the Contract Sum by Contractor; see Section 012100 "Allowances" for cash allowance for Product 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 Product Purchase contract>**.
 - d. Quantity: **<Insert quantity ordered>**.
 - e. Other Requirements: **<Insert special requirements>**.

1.10 OWNER-FURNISHED/CONTRACTOR-INSTALLED (OFCI) PRODUCTS

- A. Owner's Responsibilities: Owner will furnish products indicated and perform the following, as applicable:
 - 1. Provide to Contractor Owner-reviewed Product Data, Shop Drawings, and Samples.
 - 2. Provide for delivery of Owner-furnished products to Project site.
 - 3. Upon delivery, inspect, with Contractor present, delivered items.
 - a. If Owner-furnished products are damaged, defective, or missing, arrange for replacement.
 - 4. Obtain manufacturer's inspections, service, and warranties.
 - 5. Inform Contractor of earliest available delivery date for Owner-furnished products.
- B. Contractor's Responsibilities: The Work includes the following, as applicable:
 - 1. Designate delivery dates of Owner-furnished products in Contractor's construction schedule, utilizing Owner-furnished earliest available delivery dates.
 - 2. Review Owner-reviewed Product Data, Shop Drawings, and Samples, noting discrepancies and other issues in providing for Owner-furnished products in the Work.
 - 3. Receive, unload, handle, store, protect, and install Owner-furnished products.
 - 4. Make building services connections for Owner-furnished products.
 - 5. Protect Owner-furnished products from damage during storage, handling, and installation and prior to Substantial Completion.
 - 6. Repair or replace Owner-furnished products damaged following receipt.
- C. Owner-Furnished/Contractor-Installed (OFCI) Products:
 - 1. **<Insert description, in separate subparagraphs, for each Owner-**

furnished/Contractor-installed product>.

1.11 OWNER-FURNISHED/OWNER-INSTALLED (OFOI) PRODUCTS

- A. The Owner will furnish and install products indicated.
- B. Owner-Furnished/Owner-Installed (OFOI) Products:
 - 1. **<Insert description, in separate subparagraphs, for each Owner-furnished/Owner-installed product>.**

1.12 CONTRACTOR-FURNISHED/OWNER-INSTALLED (CFOI) 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 (CFOI) Products:
 - 1. **<Insert description, in separate subparagraphs, for each Contractor-furnished/Owner-installed product>.**

1.13 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Unrestricted Use of Site: **[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. Restricted Use of Site: **[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. Limits on 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 on Use of Site: Confine construction operations to **<Insert description of areas where work is permitted>.**
 - 2. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to **40 feet** beyond building perimeter; **10 feet** beyond surface walkways, patios, surface parking, and utilities less than **12 inches** in diameter; **15 feet** beyond primary roadway curbs and main utility branch trenches; and **25 feet** beyond constructed areas with permeable surfaces (such as pervious paving areas, stormwater detention facilities, and playing fields) that require additional staging areas in order to limit compaction in the constructed area.
 - 3. Limits: Limit site disturbance, including earthwork and clearing of vegetation, to **40 feet** beyond building perimeter; **15 feet** beyond surface walkways, patios, surface parking, and utilities; and **25 feet** beyond constructed areas with permeable surfaces that require additional staging areas to limit compaction in the constructed areas.
 - 4. 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.

1.14 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project 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]** 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]** 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.

1.15 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
 - B. On-Site Work Hours: Limit work to between <7:00> a.m. to <3:00> p.m., Monday through Friday, unless otherwise indicated. Work hours may be modified to meet Project requirements if approved by Owner and authorities having jurisdiction.
 1. Weekend Hours: <To be coordinated with Owner representative>.
 2. Early Morning Hours: <To be coordinated with Owner representative>.
 3. Hours for Utility Shutdowns: <To be coordinated with Owner representative>.
 4. Hours for [Core Drilling] <Insert noisy activity>: <Insert Owner's restrictions>.
 - C. On-Site Work Day Restrictions: Do not perform work [resulting in utility shutdowns] [or] [resulting in noisy activity] on-site during work black-out days indicated in Document 003113 "Preliminary Schedules."
 - D. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
 1. Notify [Architect] & [Owner] not less than [two] days in advance of proposed utility interruptions.
 2. Obtain [Architect's] written permission before proceeding with utility interruptions.
 - E. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
 1. Notify [Architect] & [Owner] days in advance of proposed disruptive operations.
 2. Obtain [Architect's] written permission before proceeding with disruptive operations.
 - F. Nonsmoking Building: Smoking is not permitted within the building or within **25 feet** of entrances, operable windows, or outdoor-air intakes.
 - G. Smoking and Controlled Substance Restrictions: Use of tobacco products [, **alcoholic beverages,**] and other controlled substances [**on Owner's property**] is not permitted.
 - H. Employee Identification: [**Provide**] identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.
 - I. Employee Screening: Comply with Owner's requirements for [**drug**] screening of Contractor personnel working on Project site.
 1. Maintain list of approved screened personnel with Owner's representative.
- 1.16 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. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.
 3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 00 Contracting Requirements: General provisions of the Contract, including General and Supplementary Conditions, apply to all Sections of the Specifications.
- C. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- D. 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 [**scheduled on Drawings**] [**and**] [**published as part of the U.S. National CAD Standard**].
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.
- 1.17 MISCELLANEOUS PROVISIONS
- A. <Insert miscellaneous provisions>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

SECTION 012200 - UNIT PRICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
 - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.2 DEFINITIONS

- A. Unit price is[**an amount incorporated into the Agreement, applicable during the duration of the Work as**] a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, [**applicable taxes,**] overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Removal of unsatisfactory soil and replacement with satisfactory soil material.
 - 1. Description: Unsatisfactory soil excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
 - 2. Unit of Measurement: **cubic yard** of soil excavated, based on in-place surveys of volume before and after removal.
 - 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

- B. Unit Price No. 2: Mass rock excavation and replacement with satisfactory soil material.
1. Description: Classified mass rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
 2. Unit of Measurement: **cubic yard** of rock excavated, based on in-place surveys of volume before and after removal.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- C. Unit Price No. 3: Trench rock excavation and replacement with satisfactory soil material.
1. Description: Classified trench rock excavation and disposal off-site and replacement with satisfactory fill material or engineered fill from off-site, as required, in accordance with Section 312000 "Earth Moving."
 2. Unit of Measurement: **cubic yard** of rock excavated, based on survey of in- place surveys volume of before and after removal.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."
- D. Unit Price No. 4: Cutting and patching of concrete slabs-on-grade.
1. Description: Cutting of new or existing concrete slabs-on-grade up to [**6 inches**] thick, removal and excavation as required, and subsequent backfill, compaction, and patching of concrete in accordance with Section 017300 "Execution." not otherwise indicated in the Contract Documents.
 2. Unit of Measurement: **square feet** of concrete removed.
- E. Unit Price No. 5: Miscellaneous and structural steel.
1. Description: Miscellaneous lintels and other supports not otherwise indicated in the Contract Documents, in accordance with Section 051200 "Structural Steel Framing" and Section 055000 "Metal Fabrications."
 2. Unit of Measurement: Cost in place of <Insert **pounds**> of fabricated steel, as indicated on itemized invoice of steel supplier.
- F. Unit Price No. 6: Elevator jack hole rock.
1. Description: Subsurface soil conditions that refuse conventional auger excavation of the elevator jack hole, in accordance with Section 142400 "Hydraulic Elevators."
 2. Unit of Measurement: Depth in <Insert **feet**> of drilling required, as indicated on the elevator Installer's invoice.
 3. Assigned Unit Cost: Owner will pay [**\$250.00**] <Insert **dollar amount**> per unit <Insert **feet**> of rock drilling required.
- G. Unit Price No. <Insert unit-price number> - <Insert unit-price item>:
1. Description: <Insert unit-price item description> in accordance with Section <Insert **Section number**> "<Insert Section title>."
 2. Unit of Measurement: <Insert unit of measurement>.
 3. Quantity Allowance: Coordinate unit price with allowance adjustment requirements in Section 012100 "Allowances."

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

END OF SECTION 012300

SECTION 012500 - SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form [**acceptable to Architect**].
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
 - b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
 - c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
 - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
 - e. Samples, where applicable or requested.
 - f. Certificates and qualification data, where applicable or requested.
 - g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.

- h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
 - i. Research reports evidencing compliance with building code in effect for Project, from **[ICC-ES]**.
 - j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
 - k. Cost information, including a proposal of change, if any, in the Contract Sum.
 - l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
 - m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
 - 3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within **[ten]** <10> days of receipt of a request for substitution. Architect will notify Contractor **[through Construction Manager]** of acceptance or rejection of proposed substitution within **[15]** days of receipt of request, or **[10]** days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.
- 1.4 **QUALITY ASSURANCE**
 - A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.
- 1.5 **PROCEDURES**
 - A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.
- 1.6 **SUBSTITUTIONS**
 - A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than **[15]** days prior to time required for preparation and review of related submittals.
 - 1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements.
 - c. Requested substitution provides sustainable design characteristics that specified

- product provided for compliance with IgCC requirements.
- d. Requested substitution provides sustainable design characteristics that specified product provided for compliance with ASHRAE 189.1 requirements.
- e. Requested substitution provides sustainable design characteristics that specified product provided for compliance with Green Globes requirements.
- f. Substitution request is fully documented and properly submitted.
- g. Requested substitution will not adversely affect Contractor's construction schedule.
- h. Requested substitution has received necessary approvals of authorities having jurisdiction.
- i. Requested substitution is compatible with other portions of the Work.
- j. Requested substitution has been coordinated with other portions of the Work.
- k. Requested substitution provides specified warranty.
- l. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience:

1. Not allowed[**unless otherwise indicated**].
2. Architect will consider requests for substitution if received within **[60]** days after **[commencement of the Work]**. Requests received after that time may be considered or rejected at discretion of Architect.
 - a. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
 - 1) Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
 - 2) Requested substitution does not require extensive revisions to the Contract Documents.
 - 3) Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - 4) Requested substitution provides sustainable design characteristics that specified product provided for compliance with LEED requirements.
 - 5) Requested substitution provides sustainable design characteristics that specified product provided for compliance with IgCC requirements.
 - 6) Requested substitution provides sustainable design characteristics that specified product provided for compliance with ASHRAE 189.1 requirements.
 - 7) Requested substitution provides sustainable design characteristics that specified product provided for compliance with Green Globes requirements.
 - 8) Substitution request is fully documented and properly submitted.
 - 9) Requested substitution will not adversely affect Contractor's construction schedule.
 - 10) Requested substitution has received necessary approvals of authorities having jurisdiction.

- 11) Requested substitution is compatible with other portions of the Work.
- 12) Requested substitution has been coordinated with other portions of the Work.
- 13) Requested substitution provides specified warranty.
- 14) If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

SECTION 012600 - CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.2 MINOR CHANGES IN THE WORK

- A. Architect will issue[**through Construction Manager**] supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on [AIA Document G710] [form included in Project Manual] [web-based Project management software].

1.3 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: [Architect] [Construction Manager] will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by [Architect] [Construction Manager] are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within [time specified in Proposal Request] [or] [20 days, when not otherwise specified,] <Insert number of days> after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use [forms provided by Owner. Sample copies are included in Project Manual] [forms acceptable to Architect] [form provided as part of web-based Project management software].
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to [Architect] [Construction Manager].
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the

- proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 4. Include costs of labor and supervision directly attributable to the change.
 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 6. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 7. Proposal Request Form: Use **[form provided by Owner. Sample copy is included in Project Manual] [form acceptable to Architect] [form provided as part of web-based Project management software]**.

1.4 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, **[Architect] [Construction Manager]** will issue a Change Order for signatures of Owner and Contractor on **[AIA Document G701] [AIA Document G701CMa] [form included in Project Manual] [form provided as part of web-based Project management software]**.

1.6 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: **[Architect] [Construction Manager]** may issue a Construction Change Directive on **[AIA Document G714] [AIA Document G714CMa] [form included in Project Manual] [form provided as part of web-based Project management software]**. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.7 WORK CHANGE DIRECTIVE

- A. Work Change Directive: **[Architect] [Construction Manager]** may issue a Work Change Directive on **[EJCDC Document C-940] [form included in Project Manual] [form provided**

as part of web-based Project management software]. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.

1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

SECTION 012900 - PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Requirements:
 - 1. Document 004373 "Proposed Schedule of Values Form" for requirements for furnishing proposed schedule of values with bid.
 - 2. Section 012100 "Allowances" for procedural requirements governing the handling and processing of allowances.
 - 3. Section 012200 "Unit Prices" for administrative requirements governing the use of unit prices.
 - 4. Section 012600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 5. Section 013200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
 - 6. Section 018113.13 "Sustainable Design Requirements - LEED 2009 for New Construction and Major Renovations" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 7. Section 018113.16 "Sustainable Design Requirements - LEED 2009 for Commercial Interiors" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 8. Section 018113.19 "Sustainable Design Requirements - LEED 2009 for Core and Shell Development" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 9. Section 018113.23 "Sustainable Design Requirements - LEED 2009 for Schools" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 10. Section 018113.14 "Sustainable Design Requirements - LEED v4 BD+C" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 11. Section 018113.17 "Sustainable Design Requirements - LEED v4 ID+C" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 12. Section 018113.43 "Sustainable Design Requirements - ASHRAE 189.1" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.
 - 13. Section 018113.53 "Sustainable Design Requirements - Green Globes" for administrative requirements governing submittal of cost breakdown information required for sustainable design documentation.

1.2 DEFINITIONS

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

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. [**Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.**]
1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
 2. Submit the schedule of values to Architect [**through Construction Manager**] at earliest possible date, but no later than [**seven**] < **Insert number** > days before the date scheduled for submittal of initial Applications for Payment.
 3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
 4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
 5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 011000 "Summary."
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Owner's name.
 - c. Owner's Project number.
 - d. Name of Architect.
 - e. Architect's Project number.
 - f. Contractor's name and address.
 - g. Date of submittal.
 2. Arrange schedule of values consistent with format of [**AIA Document G703**] [**EJCDC Document C-620**] < **Insert name and designation of standard form** >.
 3. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Change Orders (numbers) that affect value.
 - g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
 - 1) Labor.
 - 2) Materials.
 - 3) Equipment.
 4. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items

- for principal subcontract amounts in excess of [five] <Insert number> percent of the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site.
 6. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
 7. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
 8. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
 9. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
 10. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
 11. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling [five] <Insert number> percent of the Contract Sum and subcontract amount.
 12. Schedule of Values Revisions: Revise the schedule of values when Change Orders or Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.
- 1.4 APPLICATIONS FOR PAYMENT
- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by Architect[**and Construction Manager**] and paid for by Owner.
 - B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
 - C. Payment Application Times: Submit Application for Payment to Architect by the <Insert day> of the month. The period covered by each Application for Payment is one month, ending on the [last day of the month] <Insert specific day of the month>.
 1. Submit draft copy of Application for Payment [seven] <Insert number> days prior to due date for review by Architect.
 - D. Application for Payment Forms: Use [AIA Document G702 and AIA Document G703] [AIA Document G703 and AIA Document G732] [EJCDC Document C-620] <Insert name and designation of standard form> as form for Applications for Payment.
 1. Other Application for Payment forms proposed by the Contractor may be acceptable to [Architect] [Construction Manager] and Owner. Submit forms for approval with initial submittal of schedule of values.
 - E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. [Architect] [Construction

Manager] will return incomplete applications without action.

1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
 - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
 - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit [**three**] **<Insert number>** signed and notarized original copies of each Application for Payment to [**Architect**] [**Construction Manager**] by a method ensuring receipt[**within 24 hours**]. One copy shall include waivers of lien and similar attachments if required.
1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from [**entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment**] [**subcontractors, sub-subcontractors, and suppliers for construction period covered by the previous application**].
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 2. When an application shows completion of an item, submit conditional final or full waivers.
 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien.
 5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or

coincide with submittal of first Application for Payment include the following:

1. List of subcontractors.
 2. Schedule of values.
 3. Contractor's construction schedule (preliminary if not final).
 4. Combined Contractor's construction schedule (preliminary if not final) incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 5. Products list (preliminary if not final).
 6. Sustainable design action plans, including preliminary project materials cost data.
 7. Schedule of unit prices.
 8. Submittal schedule (preliminary if not final).
 9. List of Contractor's staff assignments.
 10. List of Contractor's principal consultants.
 11. Copies of building permits.
 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 13. Initial progress report.
 14. Report of preconstruction conference.
 15. Certificates of insurance and insurance policies.
 16. Performance and payment bonds.
 17. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 - a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 017700 "Closeout Procedures."
 2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Certification of completion of final punch list items.
 3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 4. Updated final statement, accounting for final changes to the Contract Sum.
 5. AIA Document G706.
 6. AIA Document G706A.
 7. AIA Document G707.
 8. Evidence that claims have been settled.
 9. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 10. Final liquidated damages settlement statement.
 11. Proof that taxes, fees, and similar obligations are paid.

12. Waivers and releases.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 - PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 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. Web-based Project management software package.
 - 6. 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.

1.2 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.

1.3 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, 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.

1.4 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 of Multiple Contracts: 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.

1.5 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** in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, 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 Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Architect to review and resolve conflicts on the coordination drawings.
- D. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
1. File Preparation Format:
 - a. Same digital data software program, version, and operating system as original Drawings.
 - b. **[DWG] [DXF] [DGN]**, Version **<Insert designation>**, operating in **[Microsoft Windows] [Apple Macintosh]** operating system.
 2. File Submittal Format: Submit or post coordination drawing files using **[format same as file preparation format] [PDF format]**.
 3. 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.

4. Architect will furnish Contractor one set of digital data files of Drawings for use in preparing coordination digital data files.
 - a. Architect makes no representations as to the accuracy or completeness of digital data files as they relate to Drawings.
 - b. Digital Data Software Program: Drawings are available in **<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]**.

1.6 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 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. Owner name.
 3. Owner's Project number.
 4. Name of Architect[**and Construction Manager**].
 5. Architect's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. 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 **[three] [seven] <Insert number>** 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 **[5] <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 management 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 **[three] [seven] <Insert number>** days if Contractor disagrees with response.

1.7 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 Management Software Package: **[Provide, administer, and use] [Use Architect's] [Use Owner's] [Use Construction Manager's]** web-based Project management software package for purposes of hosting and managing Project communication and documentation until Final Completion.
1. Web-based Project management software 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>** Project management 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. **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]:**
 - a. Autodesk, Inc.
 - b. Corecon Technologies, Inc.
 - c. Delteck Inc.
 - d. Meridian Systems, Inc.
 - e. Newforma, Inc.
 - f. Procore Technologies, Inc.
 - g. Viewpoint, Inc.; a Trimble Company.
 - h. **<Insert manufacturer's name>**.
 5. **Basis-of-Design Product:** Subject to compliance with requirements, provide **<Insert manufacturer's name; product name or designation>** or comparable product by one of the following:
- 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.
- 1.8 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 **[seven]** **<Insert number>** 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.

SECTION 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
 - 2. Section 014000 "Quality Requirements" for schedule of tests and inspections.
 - 3. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time [**belongs to Owner**] [**is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date**].
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without

adversely affecting the planned Project completion date.

- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
 - 3. **[Two] <Insert number>** paper copies, of sufficient size to display entire period or schedule, as required.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from **[commencement of the Work] [the Notice to Proceed]** until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at **[weekly] [monthly]** intervals.
- H. Material Location Reports: Submit at **[weekly] [monthly]** intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including **[phasing] [work stages] [area separations] [interim milestones] [and] [partial Owner occupancy]**.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures[, **including commissioning activities**].
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, [**list of subcontracts,**] submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - 1. Use **[Microsoft Project] [Primavera] [Meridian Prolog] [scheduling component of Project management software package specified in Section 013100 "Project Management and Coordination,"] <Insert name of specific software>** for current **[Windows] [Macintosh]** operating system.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.
 - 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

- C. Time Frame: Extend schedule from date established for **[commencement of the Work]** **[the Notice of Award]** **[the Notice to Proceed]** to date of **[Substantial Completion]** **[Final Completion]**.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than **[20]** **<Insert number>** days, unless specifically allowed by Architect.
 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. **<Insert list of major items or pieces of equipment>**.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than **[15]** **<Insert number>** days for startup and testing.
 6. Commissioning Time: Include no fewer than **[15]** **<Insert number>** days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's **[and Construction Manager's]** administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than **[30]** **<Insert number>** days for completion of punch list items and Final Completion.
- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:

- a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
- a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
9. Other Constraints: **<Insert constraints not indicated elsewhere>**.
- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion[.], **and the following interim milestones:**
1. Temporary enclosure and space conditioning.
 2. **<Insert milestones not indicated elsewhere>**.
- G. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- H. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.

3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- I. Contractor's Construction Schedule Updating: At [monthly] <Insert time> intervals, update schedule to reflect actual construction progress and activities. Issue schedule [one week] <Insert time> before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- J. Recovery Schedule: When periodic update indicates the Work is [14] <Insert number> or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- K. Distribution: Distribute copies of approved schedule to Architect[, **Construction Manager**,] Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.7 **STARTUP CONSTRUCTION SCHEDULE**
- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within [seven] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first [90] <Insert number> days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- 1.8 **GANTT-CHART SCHEDULE REQUIREMENTS**
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within [30] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in [10] <Insert number> percent increments within time bar.

1.9 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within [14] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award]. Outline significant construction activities for the first [90] <Insert number> days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a[**cost- and resource-loaded,**] time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than [60] <Insert number> days after date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - l. Activities occurring following Final Completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate

- paths with most float near the edges.
- a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, **[sustainable design documentation]**, and demonstration and training (if applicable), in the amount of **[5]** **<Insert number>** percent of the Contract Sum.
- a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with

progress meetings.

- a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
- b. Submit value summary printouts [**one week**] <Insert time> before each regularly scheduled progress meeting.

1.10 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. [**Construction**] [**Work**] Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Material Location Reports: At [**weekly**] [**monthly**] intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within [**one**] **<Insert number>** day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

- 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 013200 - CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Startup construction schedule.
 - 2. Contractor's Construction Schedule.
 - 3. Construction schedule updating reports.
 - 4. Daily construction reports.
 - 5. Material location reports.
 - 6. Site condition reports.
 - 7. Unusual event reports.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for preparing a combined Contractor's Construction Schedule.
 - 2. Section 014000 "Quality Requirements" for schedule of tests and inspections.
 - 3. Section 012900 "Payment Procedures" for schedule of values and requirements for use of cost-loaded schedule for Applications for Payment.

1.2 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction Project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.
 - 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum.
- C. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine the critical path of Project and when activities can be performed.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time [**belongs to Owner**] [**is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date**].
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without

adversely affecting the planned Project completion date.

- G. Resource Loading: The allocation of manpower and equipment necessary for completing an activity as scheduled.

1.3 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
 - 1. Working electronic copy of schedule file.
 - 2. PDF file.
 - 3. **[Two]** **<Insert number>** paper copies, of sufficient size to display entire period or schedule, as required.
- B. Startup construction schedule.
 - 1. Submittal of cost-loaded startup construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
 - 1. Submit a working digital copy of schedule, using software indicated, and labeled to comply with requirements for submittals.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
 - 1. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
 - 2. Logic Report: List of preceding and succeeding activities for each activity, sorted in ascending order by activity number and then by early start date, or actual start date if known.
 - 3. Total Float Report: List of activities sorted in ascending order of total float.
 - 4. Earnings Report: Compilation of Contractor's total earnings from **[commencement of the Work]** **[the Notice to Proceed]** until most recent Application for Payment.
- F. Construction Schedule Updating Reports: Submit with Applications for Payment.
- G. Daily Construction Reports: Submit at **[weekly]** **[monthly]** intervals.
- H. Material Location Reports: Submit at **[weekly]** **[monthly]** intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Unusual Event Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

1.4 QUALITY ASSURANCE

- A. Scheduling Consultant Qualifications: An experienced specialist in CPM scheduling and reporting, with capability of producing CPM reports and diagrams within 24 hours of Architect's request.
- B. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to the preliminary construction schedule and Contractor's Construction Schedule, including, but not limited to, the following:
 - 1. Review software limitations and content and format for reports.
 - 2. Verify availability of qualified personnel needed to develop and update schedule.
 - 3. Discuss constraints, including **[phasing] [work stages] [area separations] [interim milestones] [and] [partial Owner occupancy]**.
 - 4. Review delivery dates for Owner-furnished products.
 - 5. Review schedule for work of Owner's separate contracts.
 - 6. Review submittal requirements and procedures.
 - 7. Review time required for review of submittals and resubmittals.
 - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9. Review time required for Project closeout and Owner startup procedures[, **including commissioning activities**].
 - 10. Review and finalize list of construction activities to be included in schedule.
 - 11. Review procedures for updating schedule.

1.5 COORDINATION

- A. Coordinate Contractor's Construction Schedule with the schedule of values, [**list of subcontracts,**] submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities, and schedule them in proper sequence.

1.6 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.
 - 1. Use **[Microsoft Project] [Primavera] [Meridian Prolog] [scheduling component of Project management software package specified in Section 013100 "Project Management and Coordination,"] <Insert name of specific software>** for current **[Windows] [Macintosh]** operating system.
- B. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting, using CPM scheduling.
 - 1. In-House Option: Owner may waive requirement to retain a consultant if Contractor employs skilled personnel with experience in CPM scheduling and reporting techniques. Submit qualifications.
 - 2. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.

- C. Time Frame: Extend schedule from date established for **[commencement of the Work]** **[the Notice of Award]** **[the Notice to Proceed]** to date of **[Substantial Completion]** **[Final Completion]**.
1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D. Activities: Treat each floor or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
1. Activity Duration: Define activities so no activity is longer than **[20]** **<Insert number>** days, unless specifically allowed by Architect.
 2. Temporary Facilities: Indicate start and completion dates for the following as applicable:
 - a. Securing of approvals and permits required for performance of the Work.
 - b. Temporary facilities.
 - c. Construction of mock-ups, prototypes and samples.
 - d. Owner interfaces and furnishing of items.
 - e. Interfaces with Separate Contracts.
 - f. Regulatory agency approvals.
 - g. Punch list.
 3. Procurement Activities: Include procurement process activities for the following long lead-time items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 - a. **<Insert list of major items or pieces of equipment>**.
 4. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with submittal schedule.
 5. Startup and Testing Time: Include no fewer than **[15]** **<Insert number>** days for startup and testing.
 6. Commissioning Time: Include no fewer than **[15]** **<Insert number>** days for commissioning.
 7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's **[and Construction Manager's]** administrative procedures necessary for certification of Substantial Completion.
 8. Punch List and Final Completion: Include not more than **[30]** **<Insert number>** days for completion of punch list items and Final Completion.
- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work under More Than One Contract: Include a separate activity for each contract.
 3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
 4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 5. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 011000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 6. Work Restrictions: Show the effect of the following items on the schedule:

- a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial occupancy before Substantial Completion.
 - e. Use-of-premises restrictions.
 - f. Provisions for future construction.
 - g. Seasonal variations.
 - h. Environmental control.
7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
- a. Subcontract awards.
 - b. Submittals.
 - c. Purchases.
 - d. Mockups.
 - e. Fabrication.
 - f. Sample testing.
 - g. Deliveries.
 - h. Installation.
 - i. Tests and inspections.
 - j. Adjusting.
 - k. Curing.
 - l. Building flush-out.
 - m. Startup and placement into final use and operation.
 - n. Commissioning.
8. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
- a. Structural completion.
 - b. Temporary enclosure and space conditioning.
 - c. Permanent space enclosure.
 - d. Completion of mechanical installation.
 - e. Completion of electrical installation.
 - f. Substantial Completion.
9. Other Constraints: **<Insert constraints not indicated elsewhere>**.
- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion[.], **and the following interim milestones:**
1. Temporary enclosure and space conditioning.
 2. **<Insert milestones not indicated elsewhere>**.
- G. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
1. See Section 012900 "Payment Procedures" for cost reporting and payment procedures.
- H. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
1. Unresolved issues.
 2. Unanswered Requests for Information.

3. Rejected or unreturned submittals.
 4. Notations on returned submittals.
 5. Pending modifications affecting the Work and the Contract Time.
- I. Contractor's Construction Schedule Updating: At [monthly] <Insert time> intervals, update schedule to reflect actual construction progress and activities. Issue schedule [one week] <Insert time> before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 3. As the Work progresses, indicate Final Completion percentage for each activity.
- J. Recovery Schedule: When periodic update indicates the Work is [14] <Insert number> or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, equipment required to achieve compliance, and date by which recovery will be accomplished.
- K. Distribution: Distribute copies of approved schedule to Architect[, **Construction Manager**,] Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.
- 1.7 **STARTUP CONSTRUCTION SCHEDULE**
- A. Gantt-Chart Schedule: Submit startup, horizontal, Gantt-chart-type construction schedule within [seven] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first [90] <Insert number> days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- 1.8 **GANTT-CHART SCHEDULE REQUIREMENTS**
- A. Gantt-Chart Schedule: Submit a comprehensive, fully developed, horizontal, Gantt-chart-type, Contractor's Construction Schedule within [30] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
1. Base schedule on the startup construction schedule and additional information received since the start of Project.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line.
1. For construction activities that require three months or longer to complete, indicate an estimated completion percentage in [10] <Insert number> percent increments within time bar.

1.9 CPM SCHEDULE REQUIREMENTS

- A. Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within [14] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award]. Outline significant construction activities for the first [90] <Insert number> days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's Construction Schedule using a[**cost- and resource-loaded,**] time-scaled CPM network analysis diagram for the Work.
 - 1. Develop network diagram in sufficient time to submit CPM schedule, so it can be accepted for use no later than [60] <Insert number> days after date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].
 - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates.
 - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
 - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
 - 4. Use "one workday" as the unit of time for individual activities. Indicate nonworking days and holidays incorporated into the schedule to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify probable critical paths.
 - 1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
 - a. Preparation and processing of submittals.
 - b. Mobilization and demobilization.
 - c. Purchase of materials.
 - d. Delivery.
 - e. Fabrication.
 - f. Utility interruptions.
 - g. Installation.
 - h. Work by Owner that may affect or be affected by Contractor's activities.
 - i. Testing and inspection.
 - j. Commissioning.
 - k. Punch list and Final Completion.
 - l. Activities occurring following Final Completion.
 - 2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
 - 3. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
 - 4. Format: Mark the critical path. Locate the critical path near center of network; locate

- paths with most float near the edges.
- a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
5. Cost- and Resource-Loading of CPM Schedule: Assign cost to construction activities on the CPM schedule. Do not assign costs to submittal activities. Obtain Architect's approval prior to assigning costs to fabrication and delivery activities. Assign costs under main subcontracts for testing and commissioning activities, operation and maintenance manuals, punch list activities, Project record documents, **[sustainable design documentation]**, and demonstration and training (if applicable), in the amount of **[5]** **<Insert number>** percent of the Contract Sum.
- a. Each activity cost shall reflect an appropriate value subject to approval by Architect.
 - b. Total cost assigned to activities shall equal the total Contract Sum.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall Project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity.
 2. Description of activity.
 3. Main events of activity.
 4. Immediate preceding and succeeding activities.
 5. Early and late start dates.
 6. Early and late finish dates.
 7. Activity duration in workdays.
 8. Total float or slack time.
 9. Average size of workforce.
 10. Dollar value of activity (coordinated with the schedule of values).
- G. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed.
 2. Changes in early and late start dates.
 3. Changes in early and late finish dates.
 4. Changes in activity durations in workdays.
 5. Changes in the critical path.
 6. Changes in total float or slack time.
 7. Changes in the Contract Time.
- H. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
 2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
 3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
 4. Prepare list for ease of comparison with payment requests; coordinate timing with

progress meetings.

- a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
- b. Submit value summary printouts [**one week**] <Insert time> before each regularly scheduled progress meeting.

1.10 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
 1. List of subcontractors at Project site.
 2. List of separate contractors at Project site.
 3. Approximate count of personnel at Project site.
 4. Equipment at Project site.
 5. Material deliveries.
 6. High and low temperatures and general weather conditions, including presence of rain or snow.
 7. Testing and inspection.
 8. Accidents.
 9. Meetings and significant decisions.
 10. Unusual events.
 11. Stoppages, delays, shortages, and losses.
 12. Meter readings and similar recordings.
 13. Emergency procedures.
 14. Orders and requests of authorities having jurisdiction.
 15. Change Orders received and implemented.
 16. [**Construction**] [**Work**] Change Directives received and implemented.
 17. Services connected and disconnected.
 18. Equipment or system tests and startups.
 19. Partial completions and occupancies.
 20. Substantial Completions authorized.
- B. Material Location Reports: At [**weekly**] [**monthly**] intervals, prepare and submit a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site. Indicate the following categories for stored materials:
 1. Material stored prior to previous report and remaining in storage.
 2. Material stored prior to previous report and since removed from storage and installed.
 3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.
- D. Unusual Event Reports: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, responses by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

1. Submit unusual event reports directly to Owner within [**one**] <**Insert number**> day(s) of an occurrence. Distribute copies of report to parties affected by the occurrence.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013200

SECTION 013233 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Concealed Work photographs.
 - 3. Periodic construction photographs.
 - 4. Time-lapse sequence construction photographs.
 - 5. Final Completion construction photographs.
 - 6. Preconstruction video recordings.
 - 7. Periodic construction video recordings.
 - 8. Time-lapse sequence construction video recordings.
 - 9. Construction webcam.
- B. Related Requirements:
 - 1. Section 017700 "Closeout Procedures" for submitting photographic documentation as Project Record Documents at Project closeout.
 - 2. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 3. Section 024116 "Structure Demolition" for photographic documentation before building demolition operations commence.
 - 4. Section 024119 "Selective Demolition" for photographic documentation before selective demolition operations commence.
 - 5. Section 311000 "Site Clearing" for photographic documentation before site clearing operations commence.

1.2 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each **[photograph]** **[and]** **[video recording]**. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within **[three]** **<Insert number>** days of taking photographs.
 - 1. Submit photos **[on CD-ROM or thumb-drive]** **[by uploading to web-based Project management software site]**. Include copy of key plan indicating each photograph's location and direction.
 - 2. Identification: Provide the following information with each image description **[in file metadata tag]** **[in web-based Project management software site]**:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect **[and Construction Manager]**.
 - d. Name of Contractor.
 - e. Date photograph was taken.
 - f. Description of location, vantage point, and direction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- C. Printed Photographs: Submit **[two]** **<Insert number>** sets of prints of each photographic view within **[seven]** **<Insert number>** days of taking photographs.

1. Format: **8-by-10-inch** smooth-surface matte prints on single-weight, paper; enclosed back to back in clear plastic sleeves punched for three-ring binder. Include copy of key plan indicating each photograph's location and direction. Provide one binder for each set of prints.
 2. Identification: On back of each print, label with the following information:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect[**and Construction Manager**].
 - d. Name of Contractor.
 - e. Date photograph was taken if not date stamped by camera.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - g. Unique sequential identifier keyed to accompanying key plan.
- D. Video Recordings: Submit video recordings within [seven] <Insert number> days of recording.
1. Submit video recordings [on CD-ROM or thumb drive] [by uploading to web-based **Project management software site**]. Include copy of key plan indicating each video's location and direction.
 2. Identification: With each submittal, provide the following information [in file metadata tag] [on web-based **Project management software site**]:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect[**and Construction Manager**].
 - d. Name of Contractor.
 - e. Date video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 3. Transcript: Prepared on **8-1/2-by-11-inch** paper, punched and bound in three-ring binders. Provide label on front and spine. Include a cover sheet with label information. Include name of Project and date of video recording on each page.
- E. Time-Lapse Video: Submit time-lapse sequence video recordings within <Insert number> days of recording.
1. Submit time-lapse sequence video recordings [monthly] <Insert frequency> [on CD-ROM or thumb drive] [by uploading to web-based **Project management software site**].
 2. Identification: For each recording, provide the following information [in file metadata tag] [on web-based **Project management software site**]:
 - a. Name of Project.
 - b. Name and contact information for photographer.
 - c. Name of Architect[**and Construction Manager**].
 - d. Name of Contractor.
 - e. Date(s) and time(s) video recording was recorded.
 - f. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
- 1.3 QUALITY ASSURANCE
- A. Photographer Qualifications: An individual who has been regularly engaged as a professional photographer of construction projects for not less than three years.

- B. Construction Webcam Service Provider: A firm specializing in providing photographic equipment, web-based software, and related services for construction projects, with a record of providing satisfactory services similar to those required for Project.

1.4 FORMATS AND MEDIA

- A. Digital Photographs: Provide color images in JPG format, produced by a digital camera with minimum sensor size of [12] <Insert number> megapixels, and at an image resolution of not less than [3200 by 2400] <Insert resolution> pixels[, and with vibration-reduction technology]. Use flash in low light levels or backlit conditions.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of [12] <Insert number> megapixels and capable of recording in full high-definition mode[with vibration-reduction technology]. Provide supplemental lighting in low light levels or backlit conditions.
- C. Digital Images: Submit digital media as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
- D. Metadata: Record accurate date and time [and GPS location data]from camera.
- E. File Names: Name media files with [date] [Project area] <Insert requirement> and sequential numbering suffix.

1.5 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified photographer to take construction photographs.
- B. General: Take photographs with maximum depth of field and in focus.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Preconstruction Photographs: Before commencement of the Work, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by [Architect] [Construction Manager].
 - 1. Flag [excavation areas] [construction limits] before taking construction photographs.
 - 2. Take [20] <Insert number> photographs to show existing conditions adjacent to property before starting the Work.
 - 3. Take [20] <Insert number> photographs of existing buildings either on or adjoining property, to accurately record physical conditions at start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- D. Concealed Work Photographs: Before proceeding with installing work that will conceal other work, take photographs sufficient in number, with annotated descriptions, to record nature and location of concealed Work, including, but not limited to, the following:
 - 1. Underground utilities.
 - 2. Underslab services.
 - 3. Piping.
 - 4. Electrical conduit.
 - 5. Waterproofing and weather-resistant barriers.

6. **<Insert description of Work>.**
- E. Periodic Construction Photographs: Take [20] [50] **<Insert number>** photographs [weekly] [monthly] **<Insert time interval>** [coinciding with the cutoff date associated with each Application for Payment]. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Time-Lapse Sequence Construction Photographs: Take [20] **<Insert number>** photographs as indicated, to show status of construction and progress since last photographs were taken.
1. Frequency: Take photographs [monthly, on the same date each month] [weekly, on the same day each week] **<Insert time interval>**.
 2. Vantage Points: Following suggestions by [Architect] [Construction Manager] and Contractor, photographer to select vantage points. During each of the following construction phases, take not less than [two] **<Insert number>** of the required shots from same vantage point each time, to create a time-lapse sequence as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. Interior Work, through date of Substantial Completion.
 - e. **<Insert vantage point>**.
- G. Final Completion Construction Photographs: Take [20] [50] [100] **<Insert number>** photographs after date of Substantial Completion for submission as Project Record Documents. [Architect] [Construction Manager] will inform photographer of desired vantage points.
- H. Additional Photographs: Architect[or Construction Manager] may request photographs in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum[or in the allowance for construction photographs].
1. Three days' notice will be given, where feasible.
 2. In emergency situations, take additional photographs within 24 hours of request.
 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs are to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.
- 1.6 CONSTRUCTION VIDEO RECORDINGS
- A. Video Recording Photographer: Engage a qualified videographer to record construction video recordings.
- B. Narration: Describe scenes on video recording by [audio narration by microphone while] [or] [dubbing audio narration off-site after] video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
 2. Begin each video recording with name of Project, Contractor's name, videographer's name, and Project location.
- C. Transcript: Provide a typewritten transcript of the narration. Display images and running time captured from video recording opposite the corresponding narration segment.
- D. Preconstruction Video Recording: Before starting [**excavation**] [**demolition**] [**construction**], record video recording of Project site and surrounding properties from different vantage points, as directed by [**Architect**] [**Construction Manager**].
1. Flag [**excavation areas**] [**construction limits**] before recording construction video recordings.
 2. Show existing conditions adjacent to Project site before starting the Work.
 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of [**excavation**] [**demolition**] [**construction**].
 4. Show protection efforts by Contractor.
- E. Periodic Construction Video Recordings: Record video recording [**monthly**] [**weekly**] **<Insert time interval>** [**coinciding with the cutoff date associated with each Application for Payment**]. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time to be [**30**] **<Insert number>** minutes(s).
- F. Time-Lapse Sequence Construction Video Recordings: Record video recording to show status of construction and progress.
1. Frequency: During each of the following construction phases, set up video recorder to automatically record one frame of video recording every [**five**] **<Insert time>** minutes, from same vantage point each time, to create a time-lapse sequence of [**30 minutes**] **<Insert time>** in length as follows:
 - a. Commencement of the Work, through completion of subgrade construction.
 - b. Above-grade structural framing.
 - c. Exterior building enclosure.
 - d. **<Insert construction phase>**.
 2. Timer: Provide timer to automatically start and stop video recorder, so recording occurs only during [**daylight**] [**construction work**] hours.
 3. Vantage Points: Following suggestions by [**Architect**] [**Construction Manager**] and Contractor, photographer to select vantage points.

1.7 CONSTRUCTION WEBCAM

- A. Webcam: Provide [**one**] [**two**] **<Insert number>** fixed-location camera(s) with weatherproof housing, mounted to provide unobstructed view of construction site from location approved by Architect, with the following characteristics:
1. [**Static view**] [**Remotely controllable view with mouse-click user navigation for horizontal pan, vertical tilt, and optical zoom of 500 percent minimum**].
 2. Capable of producing minimum [**8**] [**12**] **<Insert number>** megapixel images.
 3. Provide [**pole mount,**] [**parapet mount,**] power supply, [**solar power station,**] active high-speed data connection to service provider's network, and static public IP address for each camera.
- B. Live Streaming Images: Provide web-accessible image of current site image, updated at [**five**] [**15**] **<Insert number>**-minute intervals [**during daytime operation**] [**when construction is**

underway].

- C. Web-Based Interface: Provide online interface to allow viewing of each high-definition digital still image captured and stored during construction, from the Internet.
1. Access Control: Provide password-protected access for Project team administered by Contractor, providing current image access and archival image access by date and time, with images downloadable to viewer's device.
 2. Software: Provide responsive software interface for use on computer, tablet, and mobile screens with accompanying iPhone/iPad app and Android apps.
 3. Storage: Maintain images on the website for reference during entire construction period, and for not less than 30 days after Final Completion. Provide sufficient memory on remote server to store all Project images.
 4. Online Interface: Provide website interface with Project and client information and logos, calendar-based navigation interface for selecting images, and pan and zoom capability within high-definition images.
 5. Forward and Reverse: Provide capability to browse through images, moving forward and backward in time by individual image and by day.
 6. Slideshow: Provide capability to automatically display current images from sites when there are three or more cameras used.
 7. Time-Lapse: Provide capability for online display of project time-lapse.
 8. Dashboard: Provide capability to view thumbnails of all cameras on one screen.
 9. Weather: Provide corresponding weather data for each image captured.
 10. Provide public viewer open access[**to most recent Project camera image**].
- D. Maintain cameras and web-based access in good working order, in accordance with web-based construction photographic documentation service provider's written instructions until Final Completion. Provide for service of cameras and related networking devices and software.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013233

SECTION 013300 - SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

B. Related Requirements:

1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
10. Section 018113.13 "Sustainable Design Requirements - LEED 2009 for New Construction and Major Renovations" for sustainable design submittals.
11. Section 018113.16 "Sustainable Design Requirements - LEED 2009 for Commercial Interiors" for sustainable design submittals.
12. Section 018113.19 "Sustainable Design Requirements - LEED 2009 for Core and Shell Development" for sustainable design submittals.
13. Section 018113.23 "Sustainable Design Requirements - LEED 2009 for Schools" for sustainable design submittals.
14. Section 018113.14 "Sustainable Design Requirements - LEED v4 BD+C" for sustainable design submittals.
15. Section 018113.17 "Sustainable Design Requirements - LEED v4 ID+C" for sustainable design submittals.
16. Section 018113.33 "Sustainable Design Requirements - IgCC" for sustainable design submittals.
17. Section 018113.43 "Sustainable Design Requirements - ASHRAE 189.1" for sustainable design submittals.
18. Section 018113.53 "Sustainable Design Requirements - Green Globes" for sustainable design submittals.

1.2 DEFINITIONS

- A. Action Submittals:** Written and graphic information and physical samples that require

Architect's[**and Construction Manager's**] responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."

- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's[**and Construction Manager's**] responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.3 SUBMITTAL SCHEDULE

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

1.4 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
1. Project name.
 2. Date.
 3. Name of Architect.
 4. Name of Construction Manager.
 5. Name of Contractor.
 6. Name of firm or entity that prepared submittal.
 7. Names of subcontractor, manufacturer, and supplier.
 8. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.

9. Category and type of submittal.
 10. Submittal purpose and description.
 11. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 12. Drawing number and detail references, as appropriate.
 13. Indication of full or partial submittal.
 14. Location(s) where product is to be installed, as appropriate.
 15. Other necessary identification.
 16. Remarks.
 17. Signature of transmitter.
- B. Options: Identify options requiring selection by Architect.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Architect[**and Construction Manager**] on previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.
- D. Paper Submittals:
1. Place a permanent label or title block on each submittal item for identification; include name of firm or entity that prepared submittal.
 2. Provide a space approximately **[6 by 8 inches]** **<Insert dimensions>** on label or beside title block to record Contractor's review and approval markings and action taken by Architect[**and Construction Manager**].
 3. Action Submittals: Submit **[three]** **<Insert number>** paper copies of each submittal unless otherwise indicated. Architect[, **through Construction Manager,**] will return **[two]** **<Insert number>** copies.
 4. Informational Submittals: Submit **[two]** **<Insert number>** paper copies of each submittal unless otherwise indicated. Architect[**and Construction Manager**] will not return copies.
 5. Additional Copies: Unless additional copies are required for final submittal, and unless Architect[**or Construction Manager**] observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
 6. Transmittal for Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using **[AIA Document G810]** **[facsimile of sample form included in Project Manual]** transmittal form.
- E. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- F. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.
- 1.5 SUBMITTAL PROCEDURES
- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
1. Email: Prepare submittals as PDF package and transmit to Architect by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Architect.

- a. Architect[, **through Construction Manager,**] will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
 3. Paper: Prepare submittals in paper form and deliver to Architect.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. **[Architect reserves] [Architect and Construction Manager reserve]** the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on **[Architect's] [Construction Manager's]** receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow **[15] <Insert number>** days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. **[Architect] [Construction Manager]** will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Allow **[15] <Insert number>** days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow **[21] <Insert number>** days for initial review of each submittal.
 - a. **<Insert list of Specification Sections requiring sequential review>.**
 5. Concurrent Consultant Review: Where the Contract Documents indicate that submittals may be transmitted simultaneously to Architect and to Architect's consultants, allow **[15] <Insert number>** days for review of each submittal. Submittal will be returned to **[Architect] [Construction Manager, through Architect,]** before being returned to Contractor.
 - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect[**and Construction Manager**].
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 3. Resubmit submittals until they are marked with approval notation from Architect's[**and**

Construction Manager's] action stamp.

- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's[**and Construction Manager's]** action stamp.

1.6 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data[**unless submittal based on Architect's digital data drawing files is otherwise permitted**].
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 - 2. Paper Sheet Size: Except for templates, patterns, and similar full-size Drawings, submit Shop Drawings on sheets at least **[8-1/2 by 11 inches, but no larger than 30 by 42 inches]** **<Insert dimensions>**.
 - a. **[Two]** opaque (bond) copies of each submittal. Architect[, **through Construction Manager,**] will return **[one]** **<Insert number>** copy(ies).

- b. [Three] <Insert number> opaque copies of each submittal. Architect[**and Construction Manager**] will retain [two] <Insert number> copies; remainder will be returned.
 3. BIM Incorporation: [Develop and incorporate] [Construction Manager will incorporate Contractor's] Shop Drawing files into BIM established for Project.
- C. Samples: Submit Samples for review of type, color, pattern, and texture for a check of these characteristics with other materials.
 1. Transmit Samples that contain multiple, related components, such as accessories together in one submittal package.
 2. Identification: Permanently attach label on unexposed side of Samples that includes the following:
 - a. Project name and submittal number.
 - b. Generic description of Sample.
 - c. Product name and name of manufacturer.
 - d. Sample source.
 - e. Number and title of applicable Specification Section.
 - f. Specification paragraph number and generic name of each item.
 3. Email Transmittal: Provide PDF transmittal. Include digital image file illustrating Sample characteristics and identification information for record.
 4. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project software website. Enter required data in web-based software site to fully identify submittal.
 5. Paper Transmittal: Include paper transmittal, including complete submittal information indicated.
 6. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
 7. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units, showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit [one] <Insert number> full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect[, **through Construction Manager,**] will return submittal with options selected.
 8. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
 - a. Number of Samples: Submit [three] <Insert number> sets of Samples. Architect[**and Construction Manager**] will retain [two] <Insert number>

Sample sets; remainder will be returned.[**Mark up and retain one returned Sample set as a project record Sample.**]

- 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
 - 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least [**three**] **<Insert number>** sets of paired units that show approximate limits of variations.
- D. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 2. Manufacturer and product name, and model number if applicable.
 3. Number and name of room or space.
 4. Location within room or space.
- E. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- F. Design Data: Prepare and submit written and graphic information indicating compliance with indicated performance and design criteria in individual Specification Sections. Include list of assumptions and summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Number each page of submittal.
- G. Certificates:
1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
 2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
 3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
 4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
 5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
 6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.
- H. Test and Research Reports:
1. Compatibility Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for substrate

- preparation and primers required.
2. Field Test Reports: Submit written reports indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements in the Contract Documents.
 3. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
 4. Preconstruction Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements in the Contract Documents.
 5. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
 6. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
 - a. Name of evaluation organization.
 - b. Date of evaluation.
 - c. Time period when report is in effect.
 - d. Product and manufacturers' names.
 - e. Description of product.
 - f. Test procedures and results.
 - g. Limitations of use.

1.7 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 insufficient to perform services or certification required, submit a written request for additional information to Architect.
- B. Delegated Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit **[digitally signed PDF file] [and] [three] <Insert number>** paper copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.
- C. BIM Incorporation: **[Incorporate] [Construction Manager will incorporate]** delegated design drawing and data files into BIM established for Project.
 1. Prepare delegated design drawings in the following format: **[Same digital data software program, version, and operating system as original Drawings] <Insert software name and version>**.

1.8 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for

coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect[**and Construction Manager**].

- B. Contractor's Approval: Indicate Contractor's approval for each submittal with [a **uniform approval stamp**] [indication in web-based Project management software]. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

1. Architect[**and Construction Manager**] will not review submittals received from Contractor that do not have Contractor's review and approval.

1.9 ARCHITECT'S AND CONSTRUCTION MANAGER'S REVIEW

- A. Action Submittals: Architect[**and Construction Manager**] will review each submittal, indicate corrections or revisions required[, **and return**].
1. PDF Submittals: Architect[**and Construction Manager**] will indicate, via markup on each submittal, the appropriate action[.][, **as follows**:]
- a. **<Insert description of each action indicated on Architect's (and Construction Manager's) stamp>.**
2. Paper Submittals: Architect[**and Construction Manager**] will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action[.][, **as follows**:]
- a. **<Insert description of each action indicated on Architect's (and Construction Manager's) stamp>.**
3. Submittals by Web-Based Project Management Software: Architect[**and Construction Manager**] will indicate, on Project management software website, the appropriate action.
- a. Actions taken by indication on Project management software website have the following meanings:
- 1) **<Insert description of each action indicated on Architect's (and Construction Manager's) stamp>.**
- B. Informational Submittals: Architect[**and Construction Manager**] will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect[**and Construction Manager**] will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect[**and Construction Manager**].
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Architect[**and Construction Manager**] will [return without review] [discard] submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Architect without action.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013300

SECTION 013516 - ALTERATION PROJECT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes special procedures for alteration work.

1.2 DEFINITIONS

- A. Alteration Work: This term includes remodeling, renovation, repair, and maintenance work performed within existing spaces or on existing surfaces as part of the Project.
- B. Consolidate: To strengthen loose or deteriorated materials in place.
- C. Design Reference Sample: A sample that represents the Architect's prebid selection of work to be matched; it may be existing work or work specially produced for the Project.
- D. 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.
- E. Match: To blend with adjacent construction and manifest no apparent difference in material type, species, cut, form, detail, color, grain, texture, or finish; as approved by Architect.
- F. Refinish: To remove existing finishes to base material and apply new finish to match original, or as otherwise indicated.
- G. Repair: To correct damage and defects, retaining existing materials, features, and finishes. This includes patching, piecing-in, splicing, consolidating, or otherwise reinforcing or upgrading materials.
- H. Replace: To remove, duplicate, and reinstall entire item with new material. The original item is the pattern for creating duplicates unless otherwise indicated.
- I. Replicate: To reproduce in exact detail, materials, and finish unless otherwise indicated.
- J. Reproduce: To fabricate a new item, accurate in detail to the original, and from either the same or a similar material as the original, unless otherwise indicated.
- K. Retain: To keep an element or detail secure and intact.
- L. Strip: To remove existing finish down to base material unless otherwise indicated.

1.3 COORDINATION

- A. Alteration Work Subschedule: A construction schedule coordinating the sequencing and scheduling of alteration work for entire Project, including each activity to be performed, and based on Contractor's Construction Schedule. Secure time commitments for performing critical construction activities from separate entities responsible for alteration work.
 - 1. Schedule construction operations in sequence required to obtain best Work results.
 - 2. Coordinate sequence of alteration work activities to accommodate the following:
 - a. Owner's continuing occupancy of portions of existing building.

- b. Owner's partial occupancy of completed Work.
 - c. Other known work in progress.
 - d. Tests and inspections.
 - 3. Detail sequence of alteration work, with start and end dates.
 - 4. Utility Services: Indicate how long utility services will be interrupted. Coordinate shutoff, capping, and continuation of utility services.
 - 5. Use of elevator and stairs.
 - 6. Equipment Data: List gross loaded weight, axle-load distribution, and wheel-base dimension data for mobile and heavy equipment proposed for use in existing structure. Do not use such equipment without certification from Contractor's professional engineer that the structure can support the imposed loadings without damage.
 - B. Pedestrian and Vehicular Circulation: Coordinate alteration work with circulation patterns within Project building(s) and site. Some work is near circulation patterns [**and adjacent to restricted areas**] <Insert item of concern>. Circulation patterns cannot be closed off entirely and in places can be only temporarily redirected around small areas of work. [**Access to restricted areas may not be obstructed.**] Plan and execute the Work accordingly.
- 1.4 PROJECT MEETINGS FOR ALTERATION WORK
- A. Preliminary Conference for Alteration Work: Before starting alteration work, [**conduct**] [**Architect will conduct**] [**Construction Manager will conduct**] conference at [**Project site**] <Insert location>.
 - 1. Attendees: In addition to representatives of Owner, [**Construction Manager,**] Architect, and Contractor, [**Owner's insurer,**] testing service representative, specialists, and chemical-cleaner manufacturer(s) shall be represented at the meeting.
 - 2. Agenda: Discuss items of significance that could affect progress of alteration work, including review of the following:
 - a. Alteration Work Subschedule: Discuss and finalize; verify availability of materials, specialists' personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Fire-prevention plan.
 - c. Governing regulations.
 - d. Areas where existing construction is to remain and the required protection.
 - e. Hauling routes.
 - f. Sequence of alteration work operations.
 - g. Storage, protection, and accounting for salvaged and specially fabricated items.
 - h. Existing conditions, staging, and structural loading limitations of areas where materials are stored.
 - i. Qualifications of personnel assigned to alteration work and assigned duties.
 - j. Requirements for extent and quality of work, tolerances, and required clearances.
 - k. Embedded work such as flashings and lintels, special details, collection of waste, protection of occupants and the public, and condition of other construction that affects the Work or will affect the work.
 - 3. Reporting: [**Record**] [**Architect will record**] [**Construction Manager will record**] conference results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from conference.
 - B. Coordination Meetings: Conduct coordination meetings specifically for alteration work at [**weekly**] [**monthly**] <Insert interval> intervals. 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, [**Construction Manager**,] Architect, and Contractor, each specialist, supplier, installer, and other entity concerned with progress or involved in planning, coordination, or performance of alteration work activities shall be represented at these meetings. All participants at conference shall be familiar with Project and authorized to conclude matters relating to alteration work.
2. Agenda: Review and correct or approve minutes of previous coordination meeting. Review other items of significance that could affect progress of alteration work. Include topics for discussion as appropriate to status of Project.
 - a. Alteration Work Subschedule: Review progress since last coordination meeting. Determine whether each schedule item is on time, ahead of schedule, or behind schedule. Determine how construction behind schedule will be expedited with retention of quality; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities are completed within the Contract Time.
 - b. Schedule Updating: Revise Contractor's Alteration Work Subschedule after each coordination meeting where revisions to schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - c. Review present and future needs of each entity present, including review items listed in the "Preliminary Conference for Alteration Work" Paragraph in this article and the following:
 - 1) Interface requirements of alteration work with other Project Work.
 - 2) Status of submittals for alteration work.
 - 3) Access to alteration work locations.
 - 4) Effectiveness of fire-prevention plan.
 - 5) Quality and work standards of alteration work.
 - 6) Change Orders for alteration work.
3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.5 MATERIALS OWNERSHIP

- A. Historic items, relics, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, antiques, and other items of interest or value to Owner that may be encountered or uncovered during the Work, regardless of whether they were previously documented, remain Owner's property.
 1. Carefully dismantle and salvage each item or object in a manner to prevent damage and protect it from damage, then promptly deliver it to Owner where directed[**at Project site**] **<Insert location>**.

1.6 INFORMATIONAL SUBMITTALS

- A. Alteration Work Subschedule:
 1. Submit alteration work subschedule within [seven] [30] **<Insert number>** days of date established for[**commencement of alteration work**] **<Insert requirement>**.
- B. Preconstruction Documentation: Show preexisting conditions of adjoining construction and site improvements that are to remain, including finish surfaces, that might be misconstrued as damage caused by Contractor's alteration work operations.
- C. Alteration Work Program: Submit [30 days] **<Insert time>** before work begins.

- D. Fire-Prevention Plan: Submit [**30 days**] **<Insert time>** before work begins.

1.7 QUALITY ASSURANCE

- A. Specialist Qualifications: An experienced firm regularly engaged in specialty work similar in nature, materials, design, and extent to alteration work as specified in each Section and that has completed a minimum of [**five**] **<Insert number>** recent projects with a record of successful in-service performance that demonstrates the firm's qualifications to perform this work.
1. Field Supervisor Qualifications: Full-time supervisors experienced in specialty work similar in nature, material, design, and extent to that indicated for this Project. Supervisors shall be on-site when specialty work begins and during its progress. Supervisors shall not be changed during Project except for causes beyond the control of the specialist firm.
 - a. Construct new mockups of required work whenever a supervisor is replaced.
- B. Title X Requirement: Each firm conducting activities that disturb painted surfaces shall be a "Lead-Safe Certified Firm" according to 40 CFR 745, Subpart E, and use only workers that are trained in lead-safe work practices.
- C. Alteration Work Program: Prepare a written plan for alteration work for whole Project, including each phase or process and protection of surrounding materials during operations. Show compliance with indicated methods and procedures specified in this and other Sections. Coordinate this whole-Project alteration work program with specific requirements of programs required in other alteration work Sections.
1. Dust and Noise Control: Include locations of proposed temporary dust- and noise-control partitions and means of egress from occupied areas coordinated with continuing on-site operations and other known work in progress.
 2. Debris Hauling: Include plans clearly marked to show debris hauling routes, turning radii, and locations and details of temporary protective barriers.
- D. Fire-Prevention Plan: Prepare a written plan for preventing fires during the Work, including placement of fire extinguishers, fire blankets, rag buckets, and other fire-control devices during each phase or process. Coordinate plan with Owner's fire-protection equipment and requirements. Include fire-watch personnel's training, duties, and authority to enforce fire safety.
- E. Safety and Health Standard: Comply with ANSI/ASSP A10.6.

1.8 STORAGE AND HANDLING OF SALVAGED MATERIALS

- A. Salvaged Materials:
1. Clean loose dirt and debris from salvaged items unless more extensive cleaning is indicated.
 2. Pack or crate items after cleaning; cushion against damage during handling. Label 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.
- B. Salvaged Materials for Reinstallation:

1. Repair and clean items for reuse as indicated.
 2. Pack or crate items after cleaning and repairing; cushion against damage during handling. Label 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 unless otherwise indicated. Provide connections, supports, and miscellaneous materials to make items functional for use indicated.
- C. Existing Materials to Remain: Protect construction indicated to remain against damage and soiling from construction work. Where permitted by Architect, items may be dismantled and taken to a suitable, protected storage location during construction work and reinstalled in their original locations after alteration and other construction work in the vicinity is complete.
- D. Storage: Catalog and store items within a weathertight enclosure where they are protected from moisture, weather, condensation, and freezing temperatures.
1. Identify each item for reinstallation with a nonpermanent mark to document its original location. Indicate original locations on plans, elevations, sections, or photographs by annotating the identifying marks.
 2. Secure stored materials to protect from theft.
 3. Control humidity so that it does not exceed 85 percent. Maintain temperatures **5 deg F** or more above the dew point.
- E. Storage Space:
1. Owner will arrange for limited on-site location(s) for free storage of salvaged material. This storage space **[includes]** **[does not include]** security **[and climate control]** for stored material.
 2. Arrange for off-site locations for storage and protection of salvaged material that cannot be stored and protected on-site.
- 1.9 FIELD CONDITIONS
- A. Survey of Existing Conditions: Record existing conditions that affect the Work by use of **[measured drawings]** **[preconstruction photographs]** **[and]** **[preconstruction videotapes]** **<Insert requirement>**.
1. Comply with requirements specified in Section 013233 "Photographic Documentation."
- B. Discrepancies: Notify Architect of discrepancies between existing conditions and Drawings before proceeding with removal and dismantling work.
- C. Owner's Removals: Before beginning alteration work, verify in correspondence with Owner that the following items have been removed:
1. **<Insert items to be removed by Owner>**.
- D. Size Limitations in Existing Spaces: Materials, products, and equipment used for performing the Work and for transporting debris, materials, and products shall be of sizes that clear surfaces within existing spaces, areas, rooms, and openings, including temporary protection, by **[12 inches]** **<Insert dimension>** or more.

PART 2 - PRODUCTS - (Not Used)

PART 3 - EXECUTION

3.1 PROTECTION

- A. Protect persons, motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm resulting from alteration work.
 - 1. Use only proven protection methods, appropriate to each area and surface being protected.
 - 2. Provide temporary barricades, barriers, and directional signage to exclude the public from areas where alteration work is being performed.
 - 3. Erect temporary barriers to form and maintain fire-egress routes.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during alteration work.
 - 5. Contain dust and debris generated by alteration work, and prevent it from reaching the public or adjacent surfaces.
 - 6. Provide shoring, bracing, and supports as necessary. Do not overload structural elements.
 - 7. Protect floors and other surfaces along hauling routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate demolition work from other areas of the building.
- B. Temporary Protection of Materials to Remain:
 - 1. Protect existing materials with temporary protections and construction. Do not remove existing materials unless otherwise indicated.
 - 2. Do not attach temporary protection to existing surfaces except as indicated as part of the alteration work program.
- C. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
- D. Utility and Communications Services:
 - 1. Notify Owner, Architect, authorities having jurisdiction, and entities owning or controlling wires, conduits, pipes, and other services affected by alteration work before commencing operations.
 - 2. Disconnect and cap pipes and services as required by authorities having jurisdiction, as required for alteration work.
 - 3. Maintain existing services unless otherwise indicated; keep in service, and protect against damage during operations. Provide temporary services during interruptions to existing utilities.
- E. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is functioning properly.
 - 1. Prevent solids such as adhesive or mortar residue or other debris from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from alteration work.
 - 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- F. Existing Roofing: Prior to the start of work in an area, install roofing protection[**as indicated**

on Drawings].

3.2 PROTECTION FROM FIRE

- A. General: Follow fire-prevention plan and the following:
1. Comply with NFPA 241 requirements unless otherwise indicated. [**Perform duties titled "Owner's Responsibility for Fire Protection."**]
 2. Remove and keep area free of combustibles, including rubbish, paper, waste, and chemicals, unless necessary for the immediate work.
 - a. If combustible material cannot be removed, provide fire blankets to cover such materials.
- B. Heat-Generating Equipment and Combustible Materials: Comply with the following procedures while performing work with heat-generating equipment or combustible materials, including welding, torch-cutting, soldering, brazing, removing paint with heat, or other operations where open flames or implements using high heat or combustible solvents and chemicals are anticipated:
1. Obtain Owner's approval for operations involving use of [**open-flame or**] welding or other high-heat equipment. [**Use of open-flame equipment is not permitted.**] Notify Owner [**at least 72 hours**] <Insert requirement> before each occurrence, indicating location of such work.
 2. As far as practicable, restrict heat-generating equipment to shop areas or outside the building.
 3. Do not perform work with heat-generating equipment in or near rooms or in areas where flammable liquids or explosive vapors are present or thought to be present. Use a combustible gas indicator test to ensure that the area is safe.
 4. Use fireproof baffles to prevent flames, sparks, hot gases, or other high-temperature material from reaching surrounding combustible material.
 5. Prevent the spread of sparks and particles of hot metal through open windows, doors, holes, and cracks in floors, walls, ceilings, roofs, and other openings.
 6. Fire Watch: Before working with heat-generating equipment or combustible materials, station personnel to serve as a fire watch at each location where such work is performed. Fire-watch personnel shall have the authority to enforce fire safety. Station fire watch according to NFPA 51B, NFPA 241, and as follows:
 - a. Train each fire watch in the proper operation of fire-control equipment and alarms.
 - b. Prohibit fire-watch personnel from other work that would be a distraction from fire-watch duties.
 - c. Cease work with heat-generating equipment whenever fire-watch personnel are not present.
 - d. Have fire-watch personnel perform final fire-safety inspection each day beginning no sooner than [**30 minutes**] <Insert time> after conclusion of work [**in each area**] to detect hidden or smoldering fires and to ensure that proper fire prevention is maintained.
 - e. Maintain fire-watch personnel at [**each area of**] Project site until [**60 minutes**] [**two hours**] <Insert time> after conclusion of daily work.
- C. Fire-Control Devices: Provide and maintain fire extinguishers, fire blankets, and rag buckets for disposal of rags with combustible liquids. Maintain each as suitable for the type of fire risk in each work area. Ensure that nearby personnel and the fire-watch personnel are trained in fire-extinguisher and blanket use.

- D. Sprinklers: Where sprinkler protection exists and is functional, maintain it without interruption while operations are being performed. If operations are performed close to sprinklers, shield them temporarily with guards.

- 1. Remove temporary guards at the end of work shifts, whenever operations are paused, and when nearby work is complete.

3.3 PROTECTION DURING APPLICATION OF CHEMICALS

- A. Protect motor vehicles, surrounding surfaces of building, building site, plants, and surrounding buildings from harm or spillage resulting from applications of chemicals and adhesives.
- B. Cover adjacent surfaces with protective materials that are proven to resist chemicals selected for Project unless chemicals being used will not damage adjacent surfaces as indicated in alteration work program. Use covering materials and masking agents that are waterproof and UV resistant and that will not stain or leave residue on surfaces to which they are applied. Apply protective materials according to manufacturer's written instructions. Do not apply liquid masking agents or adhesives to painted or porous surfaces. When no longer needed, promptly remove protective materials.
- C. Do not apply chemicals during winds of sufficient force to spread them to unprotected surfaces.
- D. Neutralize alkaline and acid wastes and legally dispose of off Owner's property.
- E. Collect and dispose of runoff from chemical operations by legal means and in a manner that prevents soil contamination, soil erosion, undermining of paving and foundations, damage to landscaping, or water penetration into building interior.

3.4 GENERAL ALTERATION WORK

- A. Have specialty work performed only by qualified specialists.
- B. Ensure that supervisory personnel are present when work begins and during its progress.
- C. Record existing work before each procedure (preconstruction), and record progress during the work. Use digital preconstruction documentation [**photographs**] [**or**] [**video recordings**]. Comply with requirements in Section 013233 "Photographic Documentation."
- D. Perform surveys of Project site as the Work progresses to detect hazards resulting from alterations.
- E. Notify Architect of visible changes in the integrity of material or components whether from environmental causes including biological attack, UV degradation, freezing, or thawing or from structural defects including cracks, movement, or distortion.
 - 1. Do not proceed with the work in question until directed by Architect.

END OF SECTION 013516

SECTION 014000 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. 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.
- C. Related Requirements:
 - 1. Section 012100 "Allowances" for testing and inspection allowances.

1.2 DEFINITIONS

- A. Experienced: When used with an entity or individual, "experienced," unless otherwise further described, means having successfully completed a minimum of [five] <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 and Inspections: 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 Work result does not require that certain construction activities specified apply exclusively to specific trade(s).
- D. Mockups: Physical assemblies of portions of the Work constructed to establish the standard by which the Work will be judged. Mockups are not Samples.
 - 1. Mockups are used for one or more of the following:
 - a. Verify selections made under Sample submittals.
 - b. Demonstrate aesthetic effects.
 - c. Demonstrate the qualities of products and workmanship.
 - d. Demonstrate successful installation of interfaces between components and systems.
 - e. Perform preconstruction testing to determine system performance.
 - 2. Product Mockups: Mockups that may include multiple products, materials, or systems specified in a single Section.

- 3. In-Place Mockups: Mockups constructed on-site in their actual final location as part of permanent construction.
- 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. Unless otherwise indicated, copies of reports of tests or inspections performed for other than the Project do not meet this definition.
- 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 and Inspections: Tests and inspections that are performed at the source (e.g., plant, mill, factory, or shop).
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. The term "testing laboratory" has the same meaning as the term "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**].

1.3 DELEGATED DESIGN SERVICES

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

1.4 CONFLICTING REQUIREMENTS

- A. Conflicting Standards and Other Requirements: If compliance with two or more standards or requirements is specified and the standards or requirements establish different or conflicting requirements for minimum quantities or quality levels, inform the Architect regarding the conflict and obtain clarification prior to proceeding with the Work. Refer conflicting requirements that are different, but apparently equal, to Architect for clarification before proceeding.

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

1.5 ACTION SUBMITTALS

- A. Mockup Shop Drawings:
 - 1. Include plans, sections, elevations, and details, 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.

1.6 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. Primary 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.

1.7 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 and to coordinate Owner's quality-assurance and quality-control activities. 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**] [**does 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 the 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.

1.8 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 of 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 of whether conditions, products, and installation will affect warranty.
 5. Other required items indicated in individual Specification Sections.
- 1.9 QUALITY ASSURANCE
- A. 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 is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities be performed by entities who are recognized experts in those operations. Specialists will satisfy qualification requirements indicated and engage in the activities indicated.
 - 1. Requirements of authorities having jurisdiction supersede requirements for specialists.
- G. Testing and Inspecting Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspection indicated, as documented in accordance with ASTM E329, 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, demonstrate, repair, and perform service on installations 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 Contractor's responsibilities, including the following:
 - 1. Provide test specimens representative of proposed products and construction.
 - 2. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
 - 3. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
 - 4. Build site-assembled test assemblies and mockups, using installers who will perform same tasks for Project.
 - 5. When testing is complete, remove test specimens and test assemblies, **[and]**mockups; do not reuse products on Project.
 - 6. 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 who 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. Promptly correct unsatisfactory conditions noted by Architect's preliminary review, to the satisfaction of the Architect, before completion of final mockup.
8. Approval of mockups by the Architect does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
9. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
10. Demolish and remove mockups when directed unless otherwise indicated.

- L. Specialty Mockups: See Section 014339 "Mockups" for additional construction requirements for [integrated exterior mockups] [preconstruction laboratory mockups] [and] [room mockups].

1.10 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 specified in Section 012100 "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 will 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. Contractor's Associated Requirements and 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 and submit with each Application for Payment.
1. Schedule Contents: Include tests, inspections, and quality-control services, including Contractor- and Owner-retained services, commissioning activities, and other Project-required services paid for by other entities.
 2. 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.
- 1.11 SPECIAL TESTS AND INSPECTIONS
- A. Special Tests and Inspections: Owner will 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>.**

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
1. Date test or inspection was conducted.
 2. Description of the Work tested or inspected.
 3. Date test or inspection results were transmitted to Architect.
 4. Identification of testing agency or special inspector conducting test or inspection.

- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's[, **Commissioning Authority's**,][**and Construction Manager's**] [**and**] [**authorities' having jurisdiction**] reference during normal working hours.
 - 1. Submit log at Project closeout as part of Project Record Documents.
- 3.2 REPAIR AND PROTECTION
 - A. General: On completion of testing, inspection, sample-taking, and similar services, repair damaged construction and restore substrates and finishes.
 - 1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 017300 "Execution."
 - B. Protect construction exposed by or for quality-control service activities.
 - C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 014000

SECTION 014200 - REFERENCES

PART 1 - GENERAL

1.1 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Architect. Other terms, including "requested," "authorized," "selected," "required," and "permitted," have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms, including "shown," "noted," "scheduled," and "specified," have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Unload, temporarily store, unpack, assemble, erect, place, anchor, apply, work to dimension, finish, cure, protect, clean, and similar operations at Project site.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.2 INDUSTRY STANDARDS

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

1.3 ABBREVIATIONS AND ACRONYMS

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."
- B. Industry Organizations, List: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. **[Abbreviations and acronyms not included in this list are to mean the recognized name of the entities indicated in Gale's "Encyclopedia of Associations: National Organizations of the U.S." or in Columbia Books' "National Trade & Professional Associations of the United States."]**The information in this list is subject to change and is believed to be accurate as of the date of the Contract Documents.
1. AABC - Associated Air Balance Council; www.aabc.com.
 2. AAMA - American Architectural Manufacturers Association; (see FGIA).
 3. AAPFCO - Association of American Plant Food Control Officials; www.aapfco.org.
 4. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
 5. AATCC - American Association of Textile Chemists and Colorists; www.aatcc.org.
 6. ABMA - American Bearing Manufacturers Association; www.americanbearings.org.
 7. ABMA - American Boiler Manufacturers Association; www.abma.com.
 8. ACI - American Concrete Institute; www.concrete.org.
 9. ACP - American Clean Power; (Formerly: American Wind Energy Association); www.cleanpower.org.
 10. ACPA - American Concrete Pipe Association; www.concretepipe.org.
 11. AEIC - Association of Edison Illuminating Companies, Inc. (The); www.aeic.org.
 12. AF&PA - American Forest & Paper Association; www.afandpa.org.
 13. AGA - American Gas Association; www.aga.org.
 14. AHAM - Association of Home Appliance Manufacturers; www.aham.org.
 15. AHRI - Air-Conditioning, Heating, and Refrigeration Institute (The); www.ahrinet.org.
 16. AI - Asphalt Institute; www.asphaltinstitute.org.
 17. AIA - American Institute of Architects (The); www.aia.org.
 18. AISC - American Institute of Steel Construction; www.aisc.org.
 19. AISI - American Iron and Steel Institute; www.steel.org.
 20. AITC - American Institute of Timber Construction; (see PLIB).
 21. AMCA - Air Movement and Control Association International, Inc.; www.amca.org.
 22. AMPP - Association for Materials Protection and Performance; www.ampp.org.
 23. ANSI - American National Standards Institute; www.ansi.org.
 24. AOSA/SCST - Association of Official Seed Analysts (The)/Society of Commercial Seed Technologists (The); www.analyzeseeds.com.
 25. APA - APA - The Engineered Wood Association; www.apawood.org.
 26. APA - Architectural Precast Association; www.archprecast.org.
 27. API - American Petroleum Institute; www.api.org.
 28. ARMA - Asphalt Roofing Manufacturers Association; www.asphaltroofing.org.
 29. ASA - Acoustical Society of America; www.acousticalsociety.org.
 30. ASCE - American Society of Civil Engineers; www.asce.org.
 31. ASCE/SEI - American Society of Civil Engineers/Structural Engineering Institute; (see ASCE).

32. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers; www.ashrae.org.
33. ASME - ASME International; [American Society of Mechanical Engineers (The)]; www.asme.org.
34. ASSE - ASSE International; (American Society of Sanitary Engineering); www.asse-plumbing.org.
35. ASSP - American Society of Safety Professionals; www.assp.org.
36. ASTM - ASTM International; www.astm.org.
37. ATIS - Alliance for Telecommunications Industry Solutions; www.atis.org.
38. AVIXA - Audiovisual and Integrated Experience Association; www.avixa.org.
39. AWI - Architectural Woodwork Institute; www.awinet.org.
40. AWMAC - Architectural Woodwork Manufacturers Association of Canada; www.awmac.com.
41. AWWA - American Water Works Association; www.awwa.org.
42. AWS - American Welding Society; www.aws.org.
43. AWWA - American Water Works Association; www.awwa.org.
44. BHMA - Builders Hardware Manufacturers Association; www.buildershardware.com.
45. BIA - Brick Industry Association (The); www.gobrick.com.
46. BICSI - BICSI, Inc.; www.bicsi.org.
47. BIFMA - Business and Institutional Furniture Manufacturer's Association; www.bifma.org.
48. BISSC - Baking Industry Sanitation Standards Committee; www.bissc.org.
49. BWF - Badminton World Federation; www.bwfbadminton.com.
50. CARB - California Air Resources Board; www.arb.ca.gov.
51. CDA - Copper Development Association Inc.; www.copper.org.
52. CE - Conformite Europeenne (European Commission); www.ec.europa.eu/growth/single-market/ce-marking.
53. CEA - Canadian Electricity Association; www.electricity.ca.
54. CFFA - Chemical Fabrics and Film Association, Inc.; www.chemicalfabricsandfilm.com.
55. CFSEI - Cold-Formed Steel Engineers Institute; www.cfsei.org.
56. CGA - Compressed Gas Association; www.cganet.com.
57. CIMA - Cellulose Insulation Manufacturers Association; www.cellulose.org.
58. CISCA - Ceilings & Interior Systems Construction Association; www.cisca.org.
59. CISPI - Cast Iron Soil Pipe Institute; www.cispi.org.
60. CLFMI - Chain Link Fence Manufacturers Institute; www.chainlinkinfo.org.
61. CPA - Composite Panel Association; www.compositepanel.org.
62. CRI - Carpet and Rug Institute (The); www.carpet-rug.org.
63. CRRC - Cool Roof Rating Council; www.coolroofs.org.
64. CRSI - Concrete Reinforcing Steel Institute; www.crsi.org.
65. CSA - CSA Group; www.csagroup.org.
66. CSI - Cast Stone Institute; www.caststone.org.
67. CSI - Construction Specifications Institute (The); www.csiresources.org.
68. CSSB - Cedar Shake & Shingle Bureau; www.cedarbureau.org.
69. CTA - Consumer Technology Association; www.cta.tech.
70. CTI - Cooling Technology Institute; www.coolingtechnology.org.
71. DASMA - Door and Access Systems Manufacturers Association; www.dasma.com.
72. DHA - Decorative Hardwoods Association; www.decorativehardwoods.org.
73. DHI - Door and Hardware Institute; www.dhi.org.
74. ECIA - Electronic Components Industry Association; www.ecianow.org.

75. EIMA - EIFS Industry Members Association; www.eima.com.
76. EJMA - Expansion Joint Manufacturers Association, Inc.; www.ejma.org.
77. EOS/ESD - EOS/ESD Association, Inc.; Electrostatic Discharge Association; www.esda.org.
78. ESTA - Entertainment Services and Technology Association; www.esta.org.
79. EVO - Efficiency Valuation Organization; www.evo-world.org.
80. FCI - Fluid Controls Institute; www.fluidcontrolsintitute.org.
81. FGIA - Fenestration and Glazing Industry Alliance; <https://fgiaonline.org>.
82. FIBA - Federation Internationale de Basketball; (The International Basketball Federation); www.fiba.com.
83. FIVB - Federation Internationale de Volleyball; (The International Volleyball Federation); www.fivb.org.
84. FM Approvals - FM Approvals LLC; www.fmapprovals.com.
85. FM Global - FM Global; www.fmglobal.com.
86. FRSA - Florida Roofing and Sheet Metal Contractors Association, Inc.; www.floridarooft.com.
87. FSA - Fluid Sealing Association; www.fluidsealing.com.
88. FSC - Forest Stewardship Council U.S.; www.fscus.org.
89. GA - Gypsum Association; www.gypsum.org.
90. GS - Green Seal; www.greenseal.org.
91. HI - Hydraulic Institute; www.pumps.org.
92. HMMA - Hollow Metal Manufacturers Association; (see NAAMM).
93. IAPSC - International Association of Professional Security Consultants; www.iapsc.org.
94. IAS - International Accreditation Service; www.iasonline.org.
95. ICC - International Code Council; www.iccsafe.org.
96. ICEA - Insulated Cable Engineers Association, Inc.; www.icea.net.
97. ICPA - International Cast Polymer Association (The); www.theicpa.com.
98. ICRI - International Concrete Repair Institute, Inc.; www.icri.org.
99. IEC - International Electrotechnical Commission; www.iec.ch.
100. IEEE - Institute of Electrical and Electronics Engineers, Inc. (The); www.ieee.org.
101. IES - Illuminating Engineering Society; www.ies.org.
102. IEST - Institute of Environmental Sciences and Technology; www.iest.org.
103. IGMA - Insulating Glass Manufacturers Alliance; (see FGIA).
104. IGSHPA - International Ground Source Heat Pump Association; www.igshpa.org.
105. ILI - Indiana Limestone Institute of America, Inc.; www.iliai.com.
106. Intertek - Intertek Group; www.intertek.com.
107. ISA - International Society of Automation (The); www.isa.org.
108. ISFA - International Surface Fabricators Association; www.isfanow.org.
109. ISO - International Organization for Standardization; www.iso.org.
110. ITU - International Telecommunication Union; www.itu.int.
111. KCMA - Kitchen Cabinet Manufacturers Association; www.kcma.org.
112. LPI - Lightning Protection Institute; www.lightning.org.
113. MBMA - Metal Building Manufacturers Association; www.mbma.com.
114. MCA - Metal Construction Association; www.metalconstruction.org.
115. MFMA - Maple Flooring Manufacturers Association, Inc.; www.maplefloor.org.
116. MFMA - Metal Framing Manufacturers Association, Inc.; www.metalframingmfg.org.
117. MHI - Material Handling Industry; www.mhi.org.
118. MMPA - Moulding & Millwork Producers Association; www.wmmpa.com.
119. MPI - Master Painters Institute; www.paintinfo.com.

120. MSS - Manufacturers Standardization Society of The Valve and Fittings Industry, Inc.; www.msshq.org.
121. NAAMM - National Association of Architectural Metal Manufacturers; www.naamm.org.
122. NACE - NACE International; (National Association of Corrosion Engineers International); (see AMPP).
123. NADCA - National Air Duct Cleaners Association; www.nadca.com.
124. NAIMA - North American Insulation Manufacturers Association; www.insulationinstitute.org.
125. NALP - National Association of Landscape Professionals; www.landscapeprofessionals.org.
126. NBGQA - National Building Granite Quarries Association, Inc.; www.nbgqa.com.
127. NBI - New Buildings Institute; www.newbuildings.org.
128. NCAA - National Collegiate Athletic Association (The); www.ncaa.org.
129. NCMA - National Concrete Masonry Association; www.ncma.org.
130. NEBB - National Environmental Balancing Bureau; www.nebb.org.
131. NECA - National Electrical Contractors Association; www.necanet.org.
132. NeLMA - Northeastern Lumber Manufacturers Association; www.nelma.org.
133. NEMA - National Electrical Manufacturers Association; www.nema.org.
134. NETA - InterNational Electrical Testing Association; www.netaworld.org.
135. NFHS - National Federation of State High School Associations; www.nfhs.org.
136. NFPA - National Fire Protection Association; www.nfpa.org.
137. NFPA - NFPA International; (see NFPA).
138. NFRC - National Fenestration Rating Council; www.nfrc.org.
139. NGA - National Glass Association; www.glass.org.
140. NHLA - National Hardwood Lumber Association; www.nhla.com.
141. NLGA - National Lumber Grades Authority; www.nlga.org.
142. NOFMA - National Oak Flooring Manufacturers Association; (see NWFA).
143. NOMMA - National Ornamental & Miscellaneous Metals Association; www.nomma.org.
144. NRCA - National Roofing Contractors Association; www.nrca.net.
145. NRMCA - National Ready Mixed Concrete Association; www.nrmca.org.
146. NSF - NSF International; www.nsf.org.
147. NSI - Natural Stone Institute; www.naturalstoneinstitute.org.
148. NSPE - National Society of Professional Engineers; www.nspe.org.
149. NSSGA - National Stone, Sand & Gravel Association; www.nssga.org.
150. NTMA - National Terrazzo & Mosaic Association, Inc. (The); www.ntma.com.
151. NWFA - National Wood Flooring Association; www.nwfa.org.
152. NWRA - National Waste & Recycling Association; www.wasterecycling.org.
153. PCI - Precast/Prestressed Concrete Institute; www.pci.org.
154. PDI - Plumbing & Drainage Institute; www.pdionline.org.
155. PLASA - PLASA; www.plasa.org.
156. PLIB - Pacific Lumber Inspection Bureau; www.plib.org.
157. PVCPA - Uni-Bell PVC Pipe Association; www.uni-bell.org.
158. RCSC - Research Council on Structural Connections; www.boltcouncil.org.
159. RFCI - Resilient Floor Covering Institute; www.rfci.com.
160. RIS - Redwood Inspection Service; (see WWPA).
161. SAE - SAE International; www.sae.org.
162. SCTE - Society of Cable Telecommunications Engineers; www.scte.org.
163. SDI - Steel Deck Institute; www.sdi.org.

164. SDI - Steel Door Institute; www.steeldoor.org.
 165. SEFA - Scientific Equipment and Furniture Association (The); www.sefalabs.com.
 166. SEI/ASCE - Structural Engineering Institute/American Society of Civil Engineers; (see ASCE).
 167. SIA - Security Industry Association; www.securityindustry.org.
 168. SJI - Steel Joist Institute; www.steeljoist.org.
 169. SMA - Screen Manufacturers Association; www.smainfo.org.
 170. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association; www.smacna.org.
 171. SMPTE - Society of Motion Picture and Television Engineers; www.smpte.org.
 172. SPFA - Spray Polyurethane Foam Alliance; www.sprayfoam.org.
 173. SPIB - Southern Pine Inspection Bureau; www.spib.org.
 174. SPRI - Single Ply Roofing Industry; www.spri.org.
 175. SRCC - Solar Rating & Certification Corporation; www.solar-rating.org.
 176. SSINA - Specialty Steel Industry of North America; www.ssina.com.
 177. SSPC - SSPC: The Society for Protective Coatings; (see AMPP).
 178. STI/SPFA - Steel Tank Institute/Steel Plate Fabricators Association; www.steeltank.com.
 179. SWI - Steel Window Institute; www.steelwindows.com.
 180. SWPA - Submersible Wastewater Pump Association; www.swpa.org.
 181. TCA - Tilt-Up Concrete Association; www.tilt-up.org.
 182. TCNA - Tile Council of North America, Inc.; www.tcnatile.com.
 183. TEMA - Tubular Exchanger Manufacturers Association, Inc.; www.kbcdco.tema.org.
 184. TIA - Telecommunications Industry Association (The); www.tiaonline.org.
 185. TMS - The Masonry Society; www.masonrysociety.org.
 186. TPI - Truss Plate Institute; www.tpinst.org.
 187. TPI - Turfgrass Producers International; www.turfgrasssod.org.
 188. TRI - Tile Roofing Industry Alliance; www.tilerroofing.org.
 189. UL - Underwriters Laboratories Inc.; www.ul.org.
 190. UL LLC - UL LLC; www.ul.com.
 191. USAV - USA Volleyball; www.usavolleyball.org.
 192. USGBC - U.S. Green Building Council; www.usgbc.org.
 193. USITT - United States Institute for Theatre Technology, Inc.; www.usitt.org.
 194. WA - Wallcoverings Association; www.wallcoverings.org.
 195. WCLIB - West Coast Lumber Inspection Bureau; (see PLIB).
 196. WCMA - Window Covering Manufacturers Association; www.wcmanet.org.
 197. WDMA - Window & Door Manufacturers Association; www.wdma.com.
 198. WI - Woodwork Institute; www.woodworkinstitute.com.
 199. WSRCA - Western States Roofing Contractors Association; www.wsrca.com.
 200. WWPA - Western Wood Products Association; www.wwpa.org.
- C. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is believed to be accurate as of the date of the Contract Documents.
1. DIN - Deutsches Institut fur Normung e.V.; www.din.de.
 2. IAPMO - International Association of Plumbing and Mechanical Officials; www.iapmo.org.
 3. ICC - International Code Council; www.iccsafe.org.
 4. ICC-ES - ICC Evaluation Service, LLC; www.icc-es.org.
- D. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications

or other Contract Documents, they are to mean the recognized name of the entities in the following list. Information is subject to change and is up to date as of the date of the Contract Documents.

1. CPSC - U.S. Consumer Product Safety Commission; www.cpsc.gov.
2. DOC - U.S. Department of Commerce; www.commerce.gov.
3. DOD - U.S. Department of Defense; www.defense.gov.
4. DOE - U.S. Department of Energy; www.energy.gov.
5. DOJ - U.S. Department of Justice; www.ojp.usdoj.gov
6. DOS - U.S. Department of State; www.state.gov.
7. EPA - United States Environmental Protection Agency; www.epa.gov.
8. FAA - Federal Aviation Administration; www.faa.gov.
9. GPO - U.S. Government Publishing Office; www.gpo.gov.
10. GSA - U.S. General Services Administration; www.gsa.gov.
11. HUD - U.S. Department of Housing and Urban Development; www.hud.gov.
12. LBNL - Lawrence Berkeley National Laboratory; Energy Technologies Area; www.lbl.gov/.
13. NIST - National Institute of Standards and Technology; www.nist.gov.
14. OSHA - Occupational Safety & Health Administration; www.osha.gov.
15. TRB - Transportation Research Board; National Cooperative Highway Research Program; The National Academies; www.trb.org.
16. USACE - U.S. Army Corps of Engineers; www.usace.army.mil.
17. USDA - U.S. Department of Agriculture; Agriculture Research Service; U.S. Salinity Laboratory; www.ars.usda.gov.
18. USDA - U.S. Department of Agriculture; Rural Utilities Service; www.usda.gov.
19. USP - U.S. Pharmacopeial Convention; www.usp.org.
20. USPS - United States Postal Service; www.usps.com.

E. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they are to mean the recognized name of the standards and regulations in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. CFR - Code of Federal Regulations; Available from U.S. Government Publishing Office; www.govinfo.gov.
2. DOD - U.S. Department of Defense; Military Specifications and Standards; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
3. DSCC - Defense Supply Center Columbus; (see FS).
4. FED-STD - Federal Standard; (see FS).
5. FS - Federal Specification; Available from DLA Document Services; www.dsp.dla.mil/Specs-Standards/.
 - a. Available from Defense Standardization Program; www.dsp.dla.mil.
 - b. Available from U.S. General Services Administration; www.gsa.gov.
 - c. Available from National Institute of Building Sciences/Whole Building Design Guide; www.wbdg.org.
6. MILSPEC - Military Specification and Standards; (see DOD).
7. USAB - United States Access Board; www.access-board.gov.
8. USATBCB - U.S. Architectural & Transportation Barriers Compliance Board; (see USAB).

F. State Government Agencies: Where abbreviations and acronyms are used in Specifications or

other Contract Documents, they are to mean the recognized name of the entities in the following list. This information is subject to change and is believed to be accurate as of the date of the Contract Documents.

1. BEARHFTI; California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation; (see BHGS).
2. BHGS; State of California Bureau of Household Goods and Services; (Formerly: California Bureau of Electronic and Appliance Repair, Home Furnishings and Thermal Insulation); www.bhgs.dca.ca.gov.
3. CCR; California Code of Regulations; Office of Administrative Law; California Title 24 Energy Code; www.oal.ca.gov/publications/ccr/.
4. CDPH; California Department of Public Health; Indoor Air Quality Program; www.cdph.ca.gov/Programs/CCDPHP/DEODC/EHLB/IAQ/Pages/Main-Page.aspx.
5. CPUC; California Public Utilities Commission; www.cpuc.ca.gov.
6. SCAQMD; South Coast Air Quality Management District; www.aqmd.gov.
7. TFS; Texas A&M Forest Service; Sustainable Forestry and Economic Development; <https://tfsweb.tamu.edu/>.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

SECTION 015000 - TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 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 012100 "Allowances" for allowance for metered use of temporary utilities.

1.2 USE CHARGES

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

1.3 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. 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. Erosion- and Sedimentation-Control Plan: Show compliance with requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- E. Erosion and Sedimentation Control Plan: Show compliance with requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- F. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- G. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. 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 requirements for 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.
- H. 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.
- I. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by Owner. Include the following:
 - 1. Methods used to meet the goals and requirements of Owner.
 - 2. Concrete cutting method(s) to be used.
 - 3. Location of construction devices on the site.
 - 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 - 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with Owner.
 - 6. Indicate locations of sensitive **[research]** **[patient]** **[equipment]** **<Insert item>** areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.

1.4 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in [**the DOJ's "2010 ADA Standards for Accessible Design"**] [**and**] [**ICC A117.1**] <Insert accessibility regulation>.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

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.
- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed[**in accordance with 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.

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:
 - 1. Install water service and distribution piping in sizes and pressures adequate for construction.
 - 2. 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.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, safety shower and eyewash 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. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities [**is not permitted**] [**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**].
- E. Temporary Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- F. Electric Power Service:
 - 1. Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
 - 2. Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
 - a. Install electric power service [**overhead**] [**underground**] unless otherwise indicated.
 - b. Connect temporary service to Owner's existing power source, as directed by Owner.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
 - 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
- H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all

construction personnel. Install **[WiFi cell phone access equipment]** **[and]** **[one]** **<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.
- I. Electronic Communication Service: Provide secure WiFi wireless connection to internet with provisions for access by Architect and Owner.
- J. Project Computer: 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: **[16]** **<Insert number>** gigabyte.
 3. Disk Storage: **[1]** **<Insert number>** -terabyte hard-disk drive and combination DVD-RW/CD-RW drive.
 4. Display: **24-inch** 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 10 Professional.
 8. Productivity Software:
 - a. Microsoft Office Professional, 2013 or higher, including Word, Excel, and Outlook.
 - b. Adobe Reader DC.
 - c. WinZip 10.0 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 **[10.0]** **<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>** terrabytes, with automated backup software providing daily backups.
- 3.4 SUPPORT FACILITIES INSTALLATION
- A. Comply with the following:
1. Provide construction for temporary field offices, shops, and sheds located within construction area or within **30 feet** of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.

2. Utilize designated area within existing building for temporary field offices.
 3. 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 in accordance with 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 in accordance with 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 offsite**] [**Use designated areas of Owner's existing**] parking areas for construction personnel.
- F. Storage and Staging: [**Provide temporary offsite area**] [**Use designated areas of Project site**] for storage and staging needs.
- G. 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.
- H. 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.

- I. Waste Disposal Facilities:
 - 1. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
 - 2. 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 Division 14 elevator Section 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:
 1. Comply with[**requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent and**] requirements specified in Section 311000 "Site Clearing."
 2. 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, in accordance with [**erosion- and sedimentation-control Drawings**] [**requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent**].
 - a. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - b. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - c. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - d. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection:
 1. Comply with requirements specified in Section 015639 "Temporary Tree and Plant Protection."
 2. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. 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.
- G. 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.**]
- H. 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.
- I. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having

jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

- J. Temporary Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary egress.
- K. 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.
- L. 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.
- M. 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** polyethylene sheet on each side. Cover floor with two layers of **6-mil** polyethylene sheet, extending sheets **18 inches** 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** 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.
- N. 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 in accordance with 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. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- 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

PART 1 - GENERAL

1.1 SUMMARY

- A. The Work of this 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 controls, utilities, support facilities, temporary site fencing, and, if applicable, temporary erosion and sedimentation controls if not specified in Section 311000 "Site Clearing".
 - 2. Section 311000 "Site Clearing" for removing existing trees and shrubs and for temporary erosion- and sedimentation-control measures if not specified in Section 015000 "Temporary Facilities and Controls".
 - 3. Section 329600 "Transplanting" for relocating existing trees and plants.

1.2 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** above the ground for trees up to and including **4-inch** size at this height and as measured at a height of **12 inches** above the ground for trees larger than **4-inch** 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** above the ground line[for trees with caliper of **8 inches** or greater as measured at a height of **12 inches** 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** unless otherwise indicated] **<Insert requirement>**.
- E. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 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>.**

1.4 ACTION SUBMITTALS

- A. Product Data:
 - 1. General protection and pruning of existing trees and plants that are affected by execution of the Work, whether temporary or permanent construction
- B. Shop Drawings:
 - 1. Include plans, elevations, and sections showing trees and plants to be protected, locations of protection-zone fencing and signage, and the relationship between 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 utility boring and trenching by hand or with air spade within protection zones.
 - 4. Include existing irrigation system that will be used to water plants.
- C. Samples: For each type of the following:
 - 1. Organic Mulch: [**1-pint**] [**1-quart**] **<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.
- E. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- F. Mitigation Requirements: As required by jurisdiction or as developed by arborist, for mitigation of damage to trees and other plantings. [**Include the following:**]
 - 1. Local ordinances governing tree mitigation.
 - 2. Standards established under the approved tree mitigation report developed by the arborist.
 - 3. "Digital Guide for Plant Appraisal" by Council of Tree and Landscape Appraisers.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For arborist and tree service firm.
- B. Certification: From arborist, certifying that trees indicated to remain have been protected during construction in accordance with 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.

1.6 QUALITY ASSURANCE

- A. Arborist Qualifications: [**Certified Arborist as certified by ISA**] [**Board Certified Master 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.

1.7 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.
- D. Take precautions to protect plants from airborne contaminants, such as paint or fireproofing overspray.

PART 2 - PRODUCTS

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 blue vinyl tape around**] <Insert requirement> each tree trunk at **54 inches** 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.

3.3 TREE PROTECTION

- A. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated. Do not exceed indicated thickness of mulch.
 - 1. Apply [**2-inch**] [**4-inch**] <Insert dimension> uniform thickness of organic mulch unless otherwise indicated. Do not place mulch within [**6 inches**] <Insert dimension> of tree trunks.
 - 2. Install temporary root-protection matting over mulch to the extent indicated.
- B. Trunk Protection: Protect the trunk of each tree to remain as follows:
 - 1. Install [**2-by-4-inch**] [**2-by-6-inch**] wood planks around trunk at maximum **3 inches** apart. Minimum three planks per tree. Band together with no less than three steel bands stapled to the planks to hold them securely in place. [Wrap orange plastic construction fencing to a minimum of three layers outside slats. Fasten wrap with wire.]
 - a. Height: [**48 inches**] [**96 inches**] [**12 inches from lowest branch**] <Insert dimension>.
 - 2. Wrap trunk with [orange plastic construction fencing to **2 inches in thickness**] [minimum **1/4-inch closed-cell foam pads**]. Install [**2-by-4-inch**] [**2-by-6-inch**] wood planks around trunk over wrap at maximum **3 inches** apart. Minimum three planks per tree. Band together with no less than three steel bands stapled to the planks to hold them securely in place.
 - a. Height: [**48 inches**] [**96 inches**] [**12 inches from lowest branch**] <Insert dimension>.
 - b. <Insert requirements>.
 - c. Trunk protection to remain in place no longer than [**six months**] [**12 months**] <Insert timeframe>. If construction exceeds timeframe indicated, inspect trunk protection at [**six-month**] [**12-month**] <Insert timeframe> intervals and loosen if necessary.

3.4 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 F567 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.
 4. Plastic Fencing: Stretch fabric taut and secure to posts without bows or sags.
- 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 ft.] [35 ft.] [50 ft.] **<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 hydration of plants to assure plant survival.
- E. 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.
- 3.5 EXCAVATION
- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones in accordance with 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.
- 3.6 ROOT PRUNING
- A. Prune tree roots that are affected by temporary and permanent construction. Prune roots [as indicated 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.
 3. Temporarily support and protect roots from damage until they are permanently covered with soil.
 4. Cover exposed roots with burlap and water regularly.
 5. Backfill as soon as possible in accordance with requirements in Section 312000 "Earth Moving."
- B. Root Pruning at Edge of Protection Zone: Prune tree roots [**12 inches outside**] [**12 inches inside**] [**6 inches outside**] [**6 inches 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.

3.7 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches [**as indicated 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 in accordance with 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>.

3.8 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**] <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.

3.9 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.

3.10 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 in accordance with 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**] [**4 inches**] <Insert dimension> or smaller in caliper size.
 2. Large Trees: Provide [**one**] [**two**] <Insert number> new tree(s) of [**6-inch**] [**4-inch**] <Insert dimension> caliper size for each tree being replaced that measures more than [**6 inches**] [**4 inches**] in caliper size.
 - a. Species: [**As selected by Architect**] <Insert species>.
 3. Plant and maintain new trees as specified in Section 329300 "Plants."
- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction. Aerate [**10 ft.**] <Insert dimension> beyond drip line and no closer than [**36 inches**] <Insert dimension> to tree trunk. Drill [**2-inch-**] <Insert dimension> diameter holes a minimum of **12 inches** deep at [**24 inches**] <Insert dimension> o.c. Backfill holes with an equal mix of augered soil and sand.

END OF SECTION 015639

SECTION 016000 - PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 5. Section 014200 "References" for applicable industry standards for products specified.
 - 6. Section 01770 "Closeout Procedures" for submitting warranties.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. **[Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.]**
- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section,

provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.

- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.3 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Architect will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.4 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

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

1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.

2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.
3. See other Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

SECTION 017300 - EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering.
 - 3. Installation.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Progress cleaning.
 - 7. Starting and adjusting.
 - 8. Protection of installed construction.
 - 9. Correction of the Work.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for coordination of [**Owner-furnished products**] [, **Owner-performed work**] [, **Owner's separate contracts**], and limits on use of Project site.
 - 2. Section 013300 "Submittal Procedures" for submitting surveys.
 - 3. Section 017700 "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, replacing defective work, and final cleaning.
 - 4. Section 024119 "Selective Demolition" for demolition and removal of selected portions of the building.
 - 5. Section 078413 "Penetration Firestopping" for patching penetrations in fire-rated construction.

1.2 DEFINITIONS

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

1.3 PREINSTALLATION MEETINGS

- A. Cutting and Patching Conference: Conduct conference at [**Project site**] <Insert location>.
 - 1. Prior to [**submitting cutting and patching plan**] [**commencing work requiring cutting and patching**], review extent of cutting and patching anticipated and examine procedures for ensuring satisfactory result from cutting and patching work. Inform Architect[**and Construction Manager**] of scheduled meeting. Require representatives of each entity directly concerned with cutting and patching to attend, including the following:
 - a. Contractor's superintendent.
 - b. Trade supervisor responsible for cutting operations.
 - c. Trade supervisor(s) responsible for patching of each type of substrate.
 - d. Mechanical, electrical, and utilities subcontractors' supervisors, to the extent each trade is affected by cutting and patching operations.
 - 2. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

- B. Layout Conference: Conduct conference at **[Project site]** <**Insert location**>.
1. Prior to establishing layout of **[new]** **[new and existing]** perimeter and structural column grid(s), review building location requirements. Review benchmark, control point, and layout and dimension requirements. Inform Architect **[and Construction Manager]** of scheduled meeting. Require representatives of each entity directly concerned with Project layout to attend, including the following:
 - a. Contractor's superintendent.
 - b. **[Professional surveyor]** **[Professional engineer]** **[Contractor's personnel]** responsible for performing Project surveying and layout.
 - c. **[Professional surveyor]** **[Professional engineer]** responsible for performing site survey serving as basis for Project design.
 2. Review meanings and intent of dimensions, notes, terms, graphic symbols, and other layout information indicated on the Drawings.
 3. Review requirements for including layouts on Shop Drawings and other submittals.
 4. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[land surveyor]** **[professional engineer]**.
- B. Certified Surveys: Submit **[two]** <**Insert number**> copies signed by **[land surveyor]** **[professional engineer]**.
- C. Certificates: Submit certificate signed by **[land surveyor]** **[professional engineer]**, certifying that location and elevation of improvements comply with requirements.
- D. Cutting and Patching Plan: Submit plan describing procedures at least **[10]** <**Insert number**> days prior to the time cutting and patching will be performed. Include the following information:
1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
 2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
 3. Products: List products to be used for patching and firms or entities that will perform patching work.
 4. Dates: Indicate when cutting and patching will be performed.
 5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
 - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- E. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

1.5 CLOSEOUT SUBMITTALS

- A. Final Property Survey: Submit **[10]** <**Insert number**> copies showing the Work performed and record survey data.

1.6 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- C. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. [**Operational elements include the following:**]
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.
 - g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
 - m. **<Insert operating system>.**
 - 3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. [**Other construction elements include but are not limited to the following:**]
 - a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
 - h. **<Insert miscellaneous element>.**
 - 4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

- D. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to [**local utility**] [**Owner**] that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect[**through Construction Manager**] in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Architect[**and Construction Manager**] promptly.
- B. Engage a [**land surveyor**] [**professional engineer**] experienced in laying out the Work, using the following accepted surveying practices:
 - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
 - 2. Establish limits on use of Project site.
 - 3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
 - 4. Inform installers of lines and levels to which they must comply.
 - 5. Check the location, level and plumb, of every major element as the Work progresses.
 - 6. Notify Architect[**and Construction Manager**] when deviations from required lines and levels exceed allowable tolerances.
 - 7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.
- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and rim and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect[**and Construction Manager**].

3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect[**or Construction Manager**]. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent

- benchmarks or control points to Architect[**and Construction Manager**] before proceeding.
2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of [two] **<Insert number>** permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.
- E. Final Property Survey: Engage a [land surveyor] [professional engineer] to prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by [land surveyor] [professional engineer], that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

3.5 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain minimum headroom clearance of [96 inches] **<Insert dimension>** in occupied spaces and [90 inches] **<Insert dimension>** in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Architect. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.

- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
 - 2. Allow for building movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Architect. Fit exposed connections together to form hairline joints.

3.6 CUTTING AND PATCHING

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
 - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.
- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before

cutting to **[minimize]** **[prevent]** interruption to occupied areas.

- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 3. **[Concrete]** **[and]** **[Masonry]**: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Architect. Provide materials and comply with installation requirements specified in other Sections, where applicable.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.
 4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.7 COORDINATION OF OWNER'S PORTION OF THE WORK

- A. Site Access: Provide access to Project site for Owner's construction personnel[**and Owner's separate contractors**].
 - 1. Provide temporary facilities required for Owner-furnished, Contractor-installed[**and Owner-furnished, Owner-installed**] products.
 - 2. Refer to Section 011000 "Summary" for other requirements for Owner-furnished, Contractor-installed[**and Owner-furnished, Owner-installed**] products.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel[**and Owner's separate contractors**].
 - 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 - 2. Preinstallation Conferences: Include Owner's construction personnel[**and Owner's separate contractors**] at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.

3.8 PROGRESS CLEANING

- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above **80 deg F**.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, in accordance with regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 - 4. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces in accordance with written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from

damage and deterioration at time of Substantial Completion.

- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in [Section 015000 "Temporary Facilities and Controls."] [Section 017419 "Construction Waste Management and Disposal."]
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.9 STARTING AND ADJUSTING

- A. Coordinate startup and adjusting of equipment and operating components with requirements in Section 019113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.10 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- C. Comply with manufacturer's written instructions for temperature and relative humidity.

3.11 CORRECTION OF THE WORK

- A. Repair or remove and replace damaged, defective, or nonconforming Work. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Restore permanent facilities used during construction to their specified condition.
- D. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- E. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- F. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 017300

SECTION 017419 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous [**demolition**] [**and**] [**construction**] waste.
 - 2. Recycling nonhazardous [**demolition**] [**and**] [**construction**] waste.
 - 3. Disposing of nonhazardous [**demolition**] [**and**] [**construction**] waste.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordination of responsibilities for waste management.
 - 2. Section 042000 "Unit Masonry" for disposal requirements for masonry waste.
 - 3. Section 044313.13 "Anchored Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 4. Section 044313.16 "Adhered Stone Masonry Veneer" for disposal requirements for excess stone and stone waste.
 - 5. Section 311000 "Site Clearing" for disposition of waste resulting from site clearing and removal of above- and below-grade improvements.

1.2 DEFINITIONS

- A. Construction Waste: Building, structure, and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building, structure, and site improvement materials resulting from demolition operations.
- C. Disposal: Removal of demolition or construction waste and subsequent salvage, sale, recycling, or deposit in landfill, incinerator acceptable to authorities having jurisdiction, or designated spoil areas on Owner's property.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition and construction 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.

1.4 ACTION SUBMITTALS

- A. Waste Management Plan: Submit plan within [7] [30] <Insert number> days of date established for [commencement of the Work] [the Notice to Proceed] [the Notice of Award].

1.5 INFORMATIONAL SUBMITTALS

- A. Waste Reduction Progress Reports: Concurrent with each Application for Payment, submit report. Use [Form CWM-7 for construction waste] [and] [Form CWM-8 for demolition waste] <Insert Owner's form designation>. Include the following information:
 - 1. Material category.
 - 2. Generation point of waste.
 - 3. Total quantity of waste in **tons**.
 - 4. Quantity of waste salvaged, both estimated and actual in **tons**.
 - 5. Quantity of waste recycled, both estimated and actual in **tons**.
 - 6. Total quantity of waste recovered (salvaged plus recycled) in **tons**.
 - 7. Total quantity of waste recovered (salvaged plus recycled) as a percentage of total waste.
- B. Waste Reduction Calculations: Before request for Substantial Completion, submit calculated end-of-Project rates for salvage, recycling, and disposal as a percentage of total waste generated by the Work.
- C. Records of Donations: Indicate receipt and acceptance of salvageable waste donated to individuals and organizations. Indicate whether organization is tax exempt.
- D. Records of Sales: Indicate receipt and acceptance of salvageable waste sold to individuals and organizations. Indicate whether organization is tax exempt.
- E. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- F. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.
- G. LEED Submittal: Submit documentation to USGBC, signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Respond to questions and requests from USGBC regarding construction waste management and disposal until the USGBC has made its determination on the project's LEED certification application. Document correspondence with USGBC as informational submittals.
- H. Sustainable Design Submittal: Submit documentation to GBI-authorized Assessor signed by Contractor, tabulating total waste material, quantities diverted and means by which it is diverted, and statement that requirements for the credit have been met. Respond to questions and requests from GBI-authorized Assessor until GBI-authorized Assessor has made its determination on Project's Green Globes certification application. Document correspondence with GBI-authorized Assessor as informational submittals.

- I. Qualification Data: For **[waste management coordinator]** **[and]** **[refrigerant recovery technician]**.
- J. 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.
- K. Refrigerant Recovery: Comply with requirements in **[Section 024116 "Structure Demolition"]** **[Section 024119 "Selective Demolition"]** for refrigerant recovery submittals.

1.6 QUALITY ASSURANCE

- A. Waste Management Coordinator Qualifications: Experienced firm, or individual employed and assigned by General Contractor, with a record of successful waste management coordination of projects with similar requirements. Superintendent **[may]** **[may not]** serve as Waste Management Coordinator.
 - 1. Firm employs a LEED-Accredited Professional, certified by the USGBC, as waste management coordinator.
 - 2. Waste management coordinator may also serve as LEED coordinator.
- B. Refrigerant Recovery Technician Qualifications: **[Type I]** **[Type II]** **[Type III]** **[Universal]** certified by EPA-approved certification program.
- C. Refrigerant Recovery Technician Qualifications: Comply with requirements in **[Section 024116 "Structure Demolition."]** **[Section 024119 "Selective Demolition."]**
- D. Regulatory Requirements: Comply with transportation and disposal regulations of authorities having jurisdiction.
- E. Waste Management Conference(s): Conduct conference(s) at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of each contractor and waste management coordinator.
 - 2. Review requirements for documenting quantities of each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan according to requirements in this Section. Plan shall consist of waste identification, waste reduction work plan, and cost/revenue analysis. **[Distinguish between demolition and construction waste.]** Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of **[demolition]** **[site-clearing]** **[and]** **[construction]** waste generated by the Work. Use **[Form CWM-1 for construction**

waste] [and] [Form CWM-2 for demolition waste] <Insert Owner's form designation>. Include estimated quantities and assumptions for estimates.

- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Use [Form CWM-3 for construction waste] [and] [Form CWM-4 for demolition waste] <Insert Owner's form designation>. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work in compliance with [Section 024116 "Structure Demolition."] [Section 024119 "Selective Demolition."]
 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.
 3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location where materials separation will be performed.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there were no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Use [Form CWM-5 for construction waste] [and] [Form CWM-6 for demolition waste] <Insert Owner's form designation>. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include transportation and tipping fees and cost of collection containers and handling for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in transportation and tipping fees by donating materials.
 7. Savings in transportation and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Comply with operation, termination, and removal requirements in Section 015000 "Temporary Facilities and Controls."
- B. Waste Management Coordinator: Engage a waste management coordinator to be responsible

for implementing, monitoring, and reporting status of waste management work plan. [**Coordinator shall be present at Project site full time for duration of Project.**]

- C. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work.
 - 1. Distribute waste management plan to everyone concerned within [**three**] <Insert **number**> days of submittal return.
 - 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- D. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
 - 1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged and recycled.
 - 2. Comply with Section 015000 "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.
- E. Waste Management in Historic Zones or Areas: Transportation equipment and other materials shall be of sizes that clear surfaces within historic spaces, areas, rooms, and openings, by [**12 inches**] <Insert **dimension**> or more.

3.2 SALVAGING DEMOLITION WASTE

- A. Comply with requirements in [**Section 024116 "Structure Demolition"**] [**Section 024119 "Selective Demolition"**] [**Section 024296 "Historic Removal and Dismantling"**] for salvaging demolition waste.
- B. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 3. Store items in a secure area until installation.
 - 4. Protect items from damage during transport and storage.
 - 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- C. Salvaged Items for [**Sale**] [**and**] [**Donation**]: [**Permitted**] [**Not permitted**] on Project site.
- D. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
 - 1. Clean salvaged items.
 - 2. Pack or crate items after cleaning. Identify contents of containers with label indicating elements, date of removal, quantity, and location where removed.
 - 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**].
 - 5. Protect items from damage during transport and storage.
- E. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.

- F. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.
- G. Plumbing Fixtures: Separate by type and size.
- H. Lighting Fixtures: Separate lamps by type and protect from breakage.
- I. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING [DEMOLITION] [AND] [CONSTRUCTION] WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall **[accrue to Owner] [accrue to Contractor] [be shared equally by Owner and Contractor]**.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical according to approved construction waste management plan.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste from Owner's property and transport to recycling receiver or processor as often as required to prevent overfilling bins.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphalt Paving: Grind asphalt to maximum **[1-1/2-inch] [4-inch]** size.
 - 1. Crush asphaltic concrete paving and screen to comply with requirements in Section 312000 "Earth Moving" for use as general fill.
- B. Asphalt Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum **[1-1/2-inch] [4-inch]** size.
 - 2. Crush concrete and screen to comply with requirements in Section 312000 "Earth Moving" for use as satisfactory soil for fill or subbase.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other

metals.

1. Pulverize masonry to maximum [**3/4-inch**] [**1-inch**] [**1-1/2-inch**] [**4-inch**] size.
 - a. Crush masonry and screen to comply with requirements in Section 312000 "Earth Moving" for use as [**general fill**] [**satisfactory soil for fill or subbase**].
 - b. Crush masonry and screen to comply with requirements in Section 329300 "Plants" for use as mineral mulch.
 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
1. Structural Steel: Stack members according to size, type of member, and length.
 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members, including trim and other metals from acoustical panels and tile, and sort with other metals.
- K. Carpet[**and Pad**]: Roll large pieces tightly after removing debris, trash, adhesive, and tack strips.
1. Store clean, dry carpet[**and pad**] in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- L. Carpet Tile: Remove debris, trash, and adhesive.
1. Stack tile on pallet and store clean, dry carpet in a closed container or trailer provided by carpet reclamation agency or carpet recycler.
- M. Piping: Reduce piping to straight lengths and store by material and size. Separate supports, hangers, valves, sprinklers, and other components by material and size.
- N. Conduit: Reduce conduit to straight lengths and store by material and size.
- O. Lamps: Separate lamps by type and store according to requirements in 40 CFR 273.

3.5 RECYCLING CONSTRUCTION WASTE

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

- pieces and comply with requirements for recycling wood.
- 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:

- 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
- 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in Section 329300 "Plants" for use of clean sawdust as organic mulch.

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

- 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in Section 329300 "Plants" for use of clean ground gypsum board as inorganic soil amendment.

D. Paint: Seal containers and store by type.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged or recycled, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. General: Except for items or materials to be salvaged or recycled, remove waste materials and legally dispose of at designated spoil areas on Owner's property.
- C. Burning: Do not burn waste materials.
- D. Burning: Burning of waste materials is permitted only at designated areas on Owner's property, provided required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.

3.7 ATTACHMENTS

- A. Form CWM-1 for construction waste identification.
- B. Form CWM-2 for demolition waste identification.
- C. Form CWM-3 for construction waste reduction work plan.
- D. Form CWM-4 for demolition waste reduction work plan.
- E. Form CWM-5 for cost/revenue analysis of construction waste reduction work plan.
- F. Form CWM-6 for cost/revenue analysis of demolition waste reduction work plan.
- G. Form CWM-7 for construction waste reduction progress report.

- H. Form CWM-8 for demolition waste reduction progress report.

END OF SECTION 017419

SECTION 017700 - CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final Completion procedures.
 - 3. List of incomplete items.
 - 4. Submittal of Project warranties.
 - 5. Final cleaning.
- B. Related Requirements:
 - 1. Section 012900 "Payment Procedures" for requirements for Applications for Payment for Substantial Completion and Final Completion.
 - 2. Section 013233 "Photographic Documentation" for submitting Final Completion construction photographic documentation.
 - 3. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 4. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 5. Section 017900 "Demonstration and Training" for requirements to train Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.2 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Architect's use prior to Architect's inspection, to determine if the Work is substantially complete.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.4 CLOSEOUT SUBMITTALS

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of [10] **<Insert number>** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 - 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 - 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 - 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by [Architect] [Construction Manager]. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain [Architect's] [Construction Manager's] [Owner's] signature for receipt of submittals.
 - 5. Submit testing, adjusting, and balancing records.
 - 6. Submit sustainable design submittals not previously submitted.
 - 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of [10] **<Insert number>** days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
 - 1. Advise Owner of pending insurance changeover requirements.
 - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 - 3. Complete startup and testing of systems and equipment.
 - 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 - 6. Advise Owner of changeover in utility services.
 - 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 - 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 - 9. Complete final cleaning requirements.
 - 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.

- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of [10] <Insert number> days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect[**and Construction Manager**] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.7 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list will state that each item has been completed or otherwise resolved for acceptance.
 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 4. Submit pest-control final inspection report.
 5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Architect[**and Construction Manager**] will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.8 LIST OF INCOMPLETE ITEMS

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

4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File: Architect[, **through Construction Manager,**] will return annotated file.
 - b. PDF Electronic File: Architect[, **through Construction Manager,**] will return annotated file.
 - c. Web-Based Project Software Upload: Utilize software feature for creating and updating list of incomplete items (punch list).
 - d. [**Three**] <Insert number> Paper Copies: Architect[, **through Construction Manager,**] will return [**two**] <Insert number> copies.

1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within [**15**] <Insert number> days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 1. Submit [**on digital media acceptable to Architect**] [**by uploading to web-based project software site**] [**by email to Architect**].
- E. Warranties in Paper Form:
 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive **8-1/2-by-11-inch** paper.
 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
- F. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each

surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean in accordance with manufacturer's instructions.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean in accordance with manufacturer's instructions if visible soil or stains remain.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels that are not permanent.
 - m. Wipe surfaces of mechanical and electrical equipment[, **elevator equipment,**] and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils[**if units were operated without filters during construction or that display contamination with particulate matter on inspection**].
 - 1) Clean HVAC system in compliance with [NADCA ACR.] [Section 230130.52 "Existing HVAC Air-Distribution System Cleaning."] Provide written report on completion of cleaning.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
 - r. Clean strainers.
 - s. Leave Project clean and ready for occupancy.
- C. Pest Control: Comply with pest control requirements in Section 015000 "Temporary Facilities and Controls." Prepare written report.
- D. Construction Waste Disposal: Comply with waste-disposal requirements in [Section 015000 "Temporary Facilities and Controls."] [Section 017419 "Construction Waste

Management and Disposal."]

3.2 CORRECTION OF THE WORK

- A. Complete repair and restoration operations required by "Correction of the Work" Article in Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 3. Section 019113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

1.2 DEFINITIONS

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

1.3 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Architect[**and Commissioning Authority**] will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit [on digital media acceptable to Architect] [by uploading to web-based project software site] [by email to Architect]. Enable reviewer comments on draft submittals.
 - 2. Submit [three] <Insert number> paper copies. Architect[, through Construction Manager,] will return [two] <Insert number> copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least [30] <Insert number> days before commencing demonstration and training. Architect[**and Commissioning Authority**] will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least [15] <Insert number> days before commencing

demonstration and training. Architect[**and Commissioning Authority**] will return copy with comments.

1. Correct or revise each manual to comply with Architect's[**and Commissioning Authority's**] comments. Submit copies of each corrected manual within [15] **<Insert number>** days of receipt of Architect's[**and Commissioning Authority's**] comments and prior to commencing demonstration and training.

- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.4 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.
- B. Manuals, Paper Copy: Submit manuals in the form of hard-copy, bound and labeled volumes.
 1. Binders: Heavy-duty, three-ring, vinyl-covered, [loose-leaf] [post-type] binders, in thickness necessary to accommodate contents, sized to hold **8-1/2-by-11-inch** paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name,[**and**] subject matter of contents[, **and indicate Specification Section number on bottom of spine**]. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
 3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment. Enclose title pages and directories in clear plastic sleeves.
 4. Supplementary Text: Prepared on **8-1/2-by-11-inch** white bond paper.
 5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in

manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

1.5 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Architect.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
 - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.6 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 - 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 - 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 - 3. Tables of Contents: Include a table of contents for each emergency, operation, and

maintenance manual.

1.7 EMERGENCY MANUALS

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

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 - 2. Performance and design criteria if Contractor has delegated design responsibility.
 - 3. Operating standards.

4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.
- C. Descriptions: Include the following:
1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.
 4. Regulation and control procedures.
 5. Instructions on stopping.
 6. Normal shutdown instructions.
 7. Seasonal and weekend operating instructions.
 8. Required sequences for electric or electronic systems.
 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.
- 1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS
- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service

contracts, and warranties and bonds as described below.

- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

1. Include procedures to follow and required notifications for warranty claims.
 - J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.
 1. Do not use original project record documents as part of maintenance manuals.
- 1.10 PRODUCT MAINTENANCE MANUALS
- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
 - B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
 - C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
 - D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
 - E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
 - F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
 - G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017823

SECTION 017839 - PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 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.

1.2 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>** set(s) 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 file 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 **[annotated PDF electronic files]** **[and]** **<Insert number>** **[paper copies]** of Project's Specifications, including addenda and Contract modifications.

- C. Record Product Data: Submit [**annotated PDF electronic files and directories**] [**and**] <Insert number> [**paper copies**] 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 [**annotated PDF electronic files and directories**] [**and**] <Insert number> [**paper copies**] 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.

1.3 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or [**Construction**] [**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 prints 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 for 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.
- 1.4 RECORD SPECIFICATIONS

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

1.5 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders[, **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.

1.6 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.

1.7 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 (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 017839

SECTION 017900 - DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.
 - 2. Demonstration and training video recordings.
- B. Allowances: Furnish demonstration and training instruction time under the demonstration and training allowance as specified in Section 012100 "Allowances."
- C. Unit Price for Instruction Time: Length of instruction time will be measured by actual time spent performing demonstration and training in required location. No payment will be made for time spent assembling educational materials, setting up, or cleaning up. See requirements in Section 012200 "Unit Prices."

1.2 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For **[facilitator]** **[instructor]** **[videographer]**.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.3 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit **[two]** **<Insert number>** copies within **[seven]** **<Insert number>** days of end of each training module.
 - 1. Identification: On each copy, provide an applied label with the following information:
 - a. Name of Project.
 - b. Name and address of videographer.
 - c. Name of Architect.
 - d. Name of Construction Manager.
 - e. Name of Contractor.
 - f. Date of video recording.
 - 2. Transcript: Prepared and bound in format matching operation and maintenance manuals. Mark appropriate identification on front and spine of each binder. Include a cover sheet with same label information as the corresponding video recording. Include name of Project and date of video recording on each page.
 - 3. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label

information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.

4. At completion of training, submit complete training manual(s) for Owner's use prepared in same [paper] [and] [PDF file] format required for operation and maintenance manuals specified in Section 017823 "Operation and Maintenance Data."

1.4 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section 014000 "Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 013100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
 1. Inspect and discuss locations and other facilities required for instruction.
 2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
 3. Review required content of instruction.
 4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Architect.

1.6 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria if Contractor is delegated design responsibility.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
2. Documentation: Review the following items in detail:
 - a. Emergency manuals.
 - b. Systems and equipment operation manuals.
 - c. Systems and equipment maintenance manuals.
 - d. Product maintenance manuals.
 - e. Project Record Documents.
 - f. Identification systems.
 - g. Warranties and bonds.
 - h. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
 - a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations: Include the following, as applicable:
 - a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
 - a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
 - a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance: Include the following:
 - a. Inspection procedures.

- b. Types of cleaning agents to be used and methods of cleaning.
- c. List of cleaning agents and methods of cleaning detrimental to product.
- d. Procedures for routine cleaning.
- e. Procedures for preventive maintenance.
- f. Procedures for routine maintenance.
- g. Instruction on use of special tools.
- 8. Repairs: Include the following:
 - a. Diagnosis instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

1.7 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.8 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
 - 1. Architect will furnish an instructor to describe basis of system design, operational requirements, criteria, and regulatory requirements.
 - 2. Owner will furnish an instructor to describe Owner's operational philosophy.
 - 3. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner[, **through Architect**,][, **through Construction Manager**,] with at least **[seven]** **<Insert number>** days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of **[an oral]** **[a written]** **[a demonstration]** performance-based test.
- F. Cleanup: Collect used and leftover educational materials and **[remove from Project site]** **[give to Owner]**. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

1.9 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
 - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.
- B. Digital Video Recordings: Provide high-resolution, digital video in MPEG format, produced by a digital camera with minimum sensor resolution of [12] **<Insert number>** megapixels and capable of recording in full HD mode[**with vibration reduction technology**].
 - 1. Submit video recordings [**on CD-ROM or thumb drive**] [**by uploading to web-based Project software site**].
 - 2. File Hierarchy: Organize folder structure and file locations according to Project Manual table of contents. Provide complete screen-based menu.
 - 3. File Names: Utilize file names based on name of equipment generally described in video segment, as identified in Project specifications.
 - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the equipment demonstration and training recording that describes the following for each Contractor involved on the Project, arranged according to Project Manual table of contents:
 - a. Name of Contractor/Installer.
 - b. Business address.
 - c. Business phone number.
 - d. Point of contact.
 - e. Email address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
 - 1. Film training session(s) in segments not to exceed 15 minutes.
 - a. Produce segments to present a single significant piece of equipment per segment.
 - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
 - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
 - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by [**audio narration by microphone while**] [**dubbing audio narration off-site after**] video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

PART 2 - PRODUCTS
PART 3 - EXECUTION

END OF SECTION 017900

SECTION 024116 - STRUCTURE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Demolition and removal of buildings and site improvements.
 - 2. Removing below-grade construction.
 - 3. Disconnecting, capping or sealing, and **[abandoning in-place] [removing]** site utilities.
 - 4. Salvaging items for reuse by Owner.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for use of the premises and phasing requirements.
 - 2. Section 013200 "Construction Progress Documentation" for preconstruction photographs taken before building demolition.
 - 3. Section 024119 "Selective Demolition" for partial demolition of buildings, structures, and site improvements.
 - 4. Section 311000 "Site Clearing" for site clearing and removal of above- and below-grade site improvements not part of building demolition.

1.2 DEFINITIONS

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

1.3 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.

1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at **[Project site] <Insert location>**.
 - 1. Inspect and discuss condition of construction to be demolished.
 - 2. Review structural load limitations of existing structures.
 - 3. Review and finalize building demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review and finalize protection requirements.
 - 5. Review procedures for **[noise control] [and] [dust control]**.
 - 6. Review procedures for protection of adjacent buildings.
 - 7. Review items to be salvaged and returned to Owner.

1.5 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.
 - 1. Adjacent Buildings: Detail special measures proposed to protect adjacent buildings to remain[**including means of egress from those buildings**].
 - D. Schedule of Building Demolition Activities: Indicate the following:
 - 1. Detailed sequence of demolition work, with starting and ending dates for each activity.
 - 2. Temporary interruption of utility services.
 - 3. Shutoff and capping[**or re-routing**] of utility services.
 - E. Predemolition Photographs or Video: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 013233 "Photographic Documentation." Submit before the 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.
- 1.6 CLOSEOUT SUBMITTALS
- A. Inventory: Submit a list of items that have been removed and salvaged.
- 1.7 QUALITY ASSURANCE
- A. Refrigerant Recovery Technician Qualifications: Certified by EPA-approved certification program.
- 1.8 FIELD CONDITIONS
- A. Buildings to be demolished will be vacated and their use discontinued before start of the Work.
 - B. Buildings immediately adjacent to demolition area will be occupied. Conduct building demolition so operations of occupied buildings will not be disrupted.
 - 1. Provide not less than [72] <Insert number> hours' notice of activities that will affect operations of adjacent occupied buildings.
 - 2. Maintain access to existing walkways, exits, and other facilities used by occupants of adjacent buildings.
 - a. Do not close or obstruct walkways, exits, or other facilities used by occupants of adjacent buildings without written permission from authorities having jurisdiction.
 - C. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
 - 1. Before building demolition, Owner will remove the following items:
 - a. <Insert items to be removed by Owner>.
 - 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 materials suspected of containing 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 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 materials that are known to be present in buildings and structures to be demolished because of building operations or processes performed there.
- F. On-site storage or sale of removed items or materials is not permitted.

1.9 COORDINATION

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

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 DEMOLITION CONTRACTOR

- A. Demolition Contractor:
 1. **<Insert, in separate subparagraphs, name of Contractor prequalified to perform the Work of this Section>.**

3.2 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. **[Perform]** **[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 building demolition operations.
- 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. Inventory and record the condition of items to be removed and salvaged.

3.3 PREPARATION

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

B. Salvaged Items: Comply with the following:

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

3.4 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

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

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

3.5 PROTECTION

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

B. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of demolition.

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

1. Do not interrupt existing utilities serving adjacent occupied or operating facilities unless authorized in writing by Owner and authorities having jurisdiction.
2. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and authorities having jurisdiction.
 - a. Provide at least **[72]** **<Insert number>** hours' notice to occupants of affected buildings if shutdown of service is required during changeover.

D. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction and as indicated. Comply with requirements in Section 015000 "Temporary Facilities and Controls."

1. Protect adjacent buildings and facilities from damage due to demolition activities.
2. Protect existing site improvements, appurtenances, and landscaping to remain.
3. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.
4. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
5. Provide protection to ensure safe passage of people around building demolition area and

- to and from occupied portions of adjacent buildings and structures.
 - 6. Protect walls, windows, roofs, and other adjacent exterior construction that are to remain and that are exposed to building demolition operations.
 - 7. Erect and maintain dustproof partitions and temporary enclosures to limit dust, noise, and dirt migration to occupied portions of adjacent buildings.
- E. Remove temporary barriers and protections where hazards no longer exist. Where open excavations or other hazardous conditions remain, leave temporary barriers and protections in place.

3.6 DEMOLITION, GENERAL

- A. General: Demolish indicated buildings[**and site improvements**] completely. Use methods required to complete the Work within limitations of governing regulations and as follows:
- 1. Do not use cutting torches until work area is cleared of flammable materials. Maintain portable fire-suppression devices during flame-cutting operations.
 - 2. Maintain fire watch during and for at least **<Insert number>** hours after flame-cutting operations.
 - 3. Maintain adequate ventilation when using cutting torches.
 - 4. Locate building demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
- B. Site Access and Temporary Controls: Conduct building demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
- 1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction. Provide alternate routes around closed or obstructed trafficways if required by authorities having jurisdiction.
 - 2. Use water mist and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.
- C. Explosives: Use of explosives is not permitted.

3.7 DEMOLITION BY EXPLOSIVES

- A. Explosives: Perform explosive demolition according to governing regulations.
- 1. Obtain written permission from authorities having jurisdiction before bringing explosives to, or using explosives on, Project site.
 - 2. Do not damage adjacent structures, property, or site improvements when using explosives.
- B. Comply with recommendation in specialty explosives consultant's report.

3.8 DEMOLITION BY MECHANICAL MEANS

- A. Proceed with demolition of structural framing members systematically, from higher to lower level. Complete building demolition operations above each floor or tier before disturbing supporting members on the next lower level.
- B. Remove debris from elevated portions of the building by chute, hoist, or other device that will

convey debris to grade level in a controlled descent.

1. Remove structural framing members and lower to ground by method suitable to minimize ground impact and dust generation.
 - C. Salvage: Items to be removed and salvaged are indicated [**on Drawings.**] [**below:**]
 1. Doors and door hardware.
 2. Windows.
 3. Cabinets.
 4. Mirrors.
 5. Chalkboards.
 6. Tackboards.
 7. Marker boards.
 8. Plumbing fixtures.
 9. **<Insert items to be salvaged>.**
 - D. Below-Grade Construction: Abandon foundation walls and other below-grade construction. Cut below-grade construction flush with grade.
 - E. Below-Grade Construction: Demolish foundation walls and other below-grade construction that are within footprint of new construction and extending [**5 feet**] **<Insert dimension>** outside footprint indicated for new construction. Abandon below-grade construction outside this area.
 1. Remove below-grade construction, including basements, foundation walls, and footings, [**completely**] [to at least **6 inches below grade**] [to at least **12 inches below grade**] [**to depths indicated**].
 - F. Below-Grade Construction: Demolish foundation walls and other below-grade construction.
 1. Remove below-grade construction, including basements, foundation walls, and footings, [**completely**] [to at least **6 inches below grade**] [to at least **12 inches below grade**] [**to depths indicated**].
 - G. Existing Utilities: Abandon existing utilities and below-grade utility structures. Cut utilities flush with grade.
 - H. Existing Utilities: Demolish existing utilities and below-grade utility structures that are within [**5 feet**] **<Insert dimension>** outside footprint indicated for new construction. Abandon utilities outside this area.
 1. Fill abandoned utility structures with [**satisfactory soil materials**] [**recycled pulverized concrete**] according to backfill requirements in Section 312000 "Earth Moving."
 - I. Existing Utilities: Demolish and remove existing utilities and below-grade utility structures.
 - J. Hydraulic Elevator Systems: Demolish and remove elevator system, including cylinder, plunger, well assembly, steel well casing and liner, oil supply lines, and tanks.
- 3.9 SITE RESTORATION
- A. Below-Grade Areas: Rough grade below-grade areas ready for further excavation or new construction.
 - B. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations with [**satisfactory soil materials**] [**recycled pulverized concrete**]

[**recycled pulverized masonry**] according to backfill requirements in Section 312000 "Earth Moving."

- C. Site Grading: Uniformly rough grade area of demolished construction to a smooth surface, free from irregular surface changes. Provide a smooth transition between adjacent existing grades and new grades.

3.10 REPAIRS

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

3.11 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.
- B. Do not burn demolished materials.

3.12 CLEANING

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

END OF SECTION 024116

SECTION 030130 - MAINTENANCE OF CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of deteriorated concrete and subsequent replacement and patching.
2. Floor joint repair.
3. Epoxy crack injection.
4. Polymer overlays.
5. Polymer sealers.

1.2 ALLOWANCES

A. Allowances for maintenance of cast-in-place concrete are specified in Section 012100 "Allowances."

B. Field quality-control testing is part of testing and inspecting allowance.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1. Unit prices apply to authorized work covered by **[quantity allowances] [estimated quantities]**.
2. Unit prices apply to authorized additions to and deletions from the Work as authorized by Change Orders.

B. General: Unit prices include the cost of preparing existing construction to receive the work indicated[**and costs of field quality control required for units of work completed].**

1.4 PREINSTALLATION MEETINGS

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

1. Review methods and procedures related to concrete maintenance including, but not limited to, the following:
 - a. Verify concrete-maintenance specialist's personnel, equipment, and facilities needed to make progress and avoid delays.
 - b. Materials, material application, sequencing, tolerances, and required clearances.
 - c. Quality-control program.
 - d. Coordination with building occupants.
 - e. **<Insert agenda items>**.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, chemical composition, physical properties, test data, and mixing, preparation, and application instructions.

B. Samples: Cured Samples for each exposed product and for each color and texture specified, **[in manufacturer's standard size appropriate for each type of work] <Insert requirements or dimensions>.**

C. Samples for Initial Selection: Cured Samples for each exposed product and for each color and texture.

1. Include sets of patching-material Samples in the form of briquettes, at least [**3 inches long by 1-1/2 inches wide**] <Insert dimensions> representative of the range of concrete colors on the building. Document each Sample with product, mix, and or other information necessary to replicate it.
 2. Include sets of Samples for epoxy crack-injection adhesive and capping adhesive in the form of injection-treated, whole, dense concrete block or brick units representative of the range of required adhesive colors.
 3. Include sets of polymer-overlay Samples in the form of treated cementitious tiles at least [**4 inches long by 4 inches wide**] <Insert dimensions> representative of the range of required colors and textures.
 4. Include sets of polymer-sealer Samples in the form of treated cementitious tiles at least [**4 inches long by 4 inches wide**] <Insert dimensions> representative of the range of required colors and textures.
 5. Have each set of Samples contain a close color range of at least [**three**] [**six**] <Insert number> Samples of different mixes of materials that match the variations in existing, adjacent concrete when cured and dry.
- D. Samples for Verification: Cured Samples for each exposed product and for each color and texture specified.
1. Include Samples of each required type, color, and texture of patching material in the form of patches in drilled holes or sawed joints in sample concrete representative of the range of concrete colors on the building.
 2. Include Samples of epoxy crack-injection in the form of injection-treated, whole, dense concrete block or brick units representative of the range of required adhesive colors.
 3. Include Samples of each required type, color, and texture of polymer-overlay material in the form of cementitious tiles at least [**8 inches long by 8 inches wide**] <Insert dimensions>.
 4. Include Samples of each required type, color, and texture of polymer-sealer material in the form of cementitious tiles at least [**8 inches long by 8 inches wide**] <Insert dimensions>.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For [**concrete-maintenance specialist**] [**and**] [**manufacturers**].
 - B. Material Certificates: For each type of [**portland cement**] [**aggregate**] <Insert material> supplied for mixing or adding to products at Project site.
 - C. Product Test Reports: For each [**manufactured bonding agent**] [**cementitious patching mortar**] [**joint-filler**] [**crack-injection adhesive**] [**polymer overlay**] [**polymer sealer**] [**and**] [**composite structural reinforcement**] <Insert product>, for tests performed by manufacturer and witnessed by a qualified testing agency.
 - D. Field quality-control reports.
 - E. Quality-Control Program: Submit before work begins.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Each [**manufactured bonding-agent**] [**packaged patching-mortar**] [**joint-filler**] [**crack-injection-adhesive**] [**corrosion-inhibiting-treatment**] [**polymer-overlay**] [**polymer-sealer**] [**and**] [**composite-structural-reinforcement**] <Insert

product> manufacturer shall employ factory-authorized service representatives who are available for consultation and Project-site inspection and on-site assistance.

- B. Concrete-Maintenance Specialist Qualifications: Engage an experienced concrete-maintenance firm that employs installers and supervisors who are trained and approved by manufacturer to apply **[packaged patching-mortar]** **[crack-injection adhesive]** **[corrosion-inhibiting treatments]** **[polymer overlays]** **[polymer sealers]** **[and]** **[composite structural reinforcement]** **<Insert product>** to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing or patching new concrete is insufficient experience for concrete-maintenance work.
1. Field Supervision: Concrete-maintenance specialist firm shall maintain experienced full-time supervisors on Project site during times that concrete-maintenance work is in progress.
- C. Quality-Control Program: Prepare a written plan for concrete maintenance to systematically demonstrate the ability of personnel to properly perform maintenance work, including each phase or process, protection of surrounding materials during operations, and control of debris and runoff during the Work. Describe in detail materials, methods, equipment, and sequence of operations to be used for each phase of the Work.
- D. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
1. Concrete Removal and Patching: Remove and repair an **[approximately 50 sq. ft.]** **[approximately 100 sq. in.]** **<Insert dimension>** area of **[deteriorated concrete deck]** **[deteriorated concrete wall]** **<Insert description>**.
2. Floor Joint Repair: Cut out and reinstall joints in two separate areas [, each approximately **48 inches long**] **[as indicated on Drawings]** **<Insert dimension>**.
3. Epoxy Crack Injection: Perform epoxy crack injection in two separate areas [, each approximately **48 inches long**] **[as indicated on Drawings]** **<Insert dimension>**.
4. Polymer Overlay: Apply an **[approximately 50 sq. ft.]** **<Insert dimension>** area of polymer overlay.
5. Polymer Sealer: Apply an **[approximately 50 sq. ft.]** **<Insert dimension>** area of polymer sealer.
6. Composite Structural Reinforcement: Apply composite structural reinforcement [a minimum of **48 inches long**] **[as indicated on Drawings]** **<Insert dimension>**.
7. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
8. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Comply with manufacturer's written instructions for minimum and maximum temperature requirements and other conditions for storage.
- B. Store cementitious materials off the ground, under cover, and in a dry location.
- C. Store aggregates covered and in a dry location; maintain grading and other required characteristics and prevent contamination.

1.9 FIELD CONDITIONS

- A. Environmental Limitations for Epoxies: Do not apply when air and substrate temperatures are outside limits permitted by manufacturer. During hot weather, cool epoxy components before mixing, store mixed products in shade, and cool unused mixed products to retard setting. Do not apply to wet substrates unless approved by manufacturer.
 - 1. Use only Class A epoxies when substrate temperatures are below or are expected to go below **40 deg F** within eight hours.
 - 2. Use only Class A or B epoxies when substrate temperatures are below or are expected to go below **60 deg F** within eight hours.
 - 3. Use only Class C epoxies when substrate temperatures are above and are expected to stay above **60 deg F** for eight hours.
- B. Cold-Weather Requirements for Cementitious Materials:
 - 1. Do not apply unless concrete-surface and air temperatures are above **40 deg F** and will remain so for at least 48 hours after completion of Work.
 - 2. Comply with the following procedures:
 - a. When air temperature is below **40 deg F**, heat patching-material ingredients and existing concrete to produce temperatures between **40 and 90 deg F**.
 - b. When mean daily air temperature is between **25 and 40 deg F**, cover completed Work with weather-resistant insulating blankets for 48 hours after repair or provide enclosure and heat to maintain temperatures above **32 deg F** within the enclosure for 48 hours after repair.
 - c. When mean daily air temperature is below **25 deg F**, provide enclosure and heat to maintain temperatures above **32 deg F** within the enclosure for 48 hours after repair.
- C. Hot-Weather Requirements for Cementitious Materials: Protect repair work when temperature and humidity conditions produce excessive evaporation of water from patching materials. Provide artificial shade and wind breaks, and use cooled materials as required. Do not apply to substrates with temperatures of **90 deg F** and above.
- D. Environmental Limitations for High-Molecular-Weight Methacrylate Sealers: Do not apply when concrete surface temperature is below **55 deg F** or above **[75 deg F] [90 deg F] <Insert temperature>**. Apply only to **[dry substrates] [substrates that have been dry for at least 72 hours]**.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. For repair products, obtain each color, grade, finish, type, and variety of product from single source and from single manufacturer with resources to provide products of consistent quality in appearance and physical properties.

2.2 PREPLACED CONCRETE MATERIALS

- A. Preplaced Aggregate: Washed aggregate, ASTM C33/C33M, Class 5S, with [95 to 100 percent passing a **1-1/2-inch** sieve, **40 to 80** percent passing a **1-inch** sieve, **20 to 45** percent passing a **3/4-inch** sieve, zero to 10 percent passing a **1/2-inch** sieve, and zero to 2 percent passing a **3/8-inch** sieve] [100 percent passing a **1-1/2-inch** sieve, 95 to 100 percent passing a **1-inch** sieve, **40 to 80** percent passing a **3/4-inch** sieve, zero to 15 percent passing a **1/2-inch** sieve, and zero to 2 percent passing a **3/8-inch** sieve] **<Insert requirement>**.

- B. Fine Aggregate for Grout: Fine aggregate according to ASTM C33/C33M, but with 100 percent passing a **No. 8** sieve, 95 to 100 percent passing a **No. 16** sieve, 55 to 80 percent passing a **No. 30** sieve, 30 to 55 percent passing a **No. 50** sieve, 10 to 30 percent passing a **No. 100** sieve, zero to 10 percent passing a **No. 200** sieve, and having a fineness modulus of 1.30 to 2.10.

- C. Grout Fluidifier for Grout: ASTM C937.

- D. Pozzolans for Grout: ASTM C618.

2.3 MISCELLANEOUS MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I, II, or III unless otherwise indicated.

- B. Water: Potable.

2.4 MIXES

- A. General: Mix products, in clean containers, according to manufacturer's written instructions.
 - 1. Do not add water, thinners, or additives unless recommended by manufacturer.
 - 2. When practical, use manufacturer's premeasured packages to ensure that materials are mixed in proper proportions. When premeasured packages are not used, measure ingredients using graduated measuring containers; do not estimate quantities or use shovel or trowel as unit of measure.
 - 3. Do not mix more materials than can be used within time limits recommended by manufacturer. Discard materials that have begun to set.
- B. Mortar Scrub Coat: Mix dry ingredients with enough water to provide consistency of thick cream.
- C. Dry-Pack Mortar: Mix required type(s) of patching-mortar dry ingredients with just enough liquid to form damp cohesive mixture that can be squeezed by hand into a ball but is not plastic.
- D. Concrete: Comply with [Section 033000 "Cast-in-Place Concrete."] [Section 033300 "Architectural Concrete."]
- E. Grout for Use with Preplaced Aggregate: Proportion according to ASTM C938. Add grout fluidifier to mixing water followed by portland cement, pozzolan, and fine aggregate.

PART 3 - EXECUTION

3.1 CONCRETE-MAINTENANCE SPECIALIST

- A. Concrete-Maintenance Specialist Firms: Subject to compliance with requirements, **[have concrete maintenance performed by one of the following] [firms that may perform concrete maintenance include, but are not limited to, the following]:**
 - 1. **<Insert, in separate subparagraphs, names of concrete-maintenance specialist firms>.**

3.2 CONCRETE MAINTENANCE

- A. Have concrete-maintenance work performed only by qualified concrete-maintenance specialist.
- B. Comply with manufacturers' written instructions for surface preparation and product application.

3.3 EXAMINATION

- A. Notify Architect seven days in advance of dates when areas of deteriorated or delaminated concrete and deteriorated reinforcing bars will be located.
- B. Locate areas of deteriorated or delaminated concrete using hammer or chain-drag sounding and mark boundaries. Mark areas for removal by simplifying and squaring off boundaries. At columns and walls make boundaries level and plumb unless otherwise indicated.
- C. Pachometer Testing: Locate at least three reinforcing bars using a pachometer, and drill test holes to determine depth of cover. Calibrate pachometer using depth of cover measurements, and verify depth of cover in removal areas using pachometer.
- D. Perform surveys as the Work progresses to detect hazards resulting from concrete-maintenance work.

3.4 PREPARATION

- A. Ensure that supervisory personnel are on-site and on duty when concrete maintenance work begins and during its progress.
- B. Protect persons, motor vehicles, surrounding surfaces of building being repaired, building site, plants, and surrounding buildings from harm resulting from concrete maintenance work.
 - 1. Comply with each product manufacturer's written instructions for protections and precautions. Protect against adverse effects of products and procedures on people and adjacent materials, components, and vegetation.
 - 2. Use only proven protection methods appropriate to each area and surface being protected.
 - 3. Provide temporary barricades, barriers, and directional signage to exclude public from areas where concrete maintenance work is being performed.
 - 4. Erect temporary protective covers over walkways and at points of pedestrian and vehicular entrance and exit that must remain in service during course of concrete maintenance work.
 - 5. Contain dust and debris generated by concrete maintenance work and prevent it from reaching the public or adjacent surfaces.
 - 6. Use water-mist sprinkling and other wet methods to control dust only with adequate, approved procedures and equipment that ensure that such water will not create a hazard or adversely affect other building areas or materials.
 - 7. Protect floors and other surfaces along haul routes from damage, wear, and staining.
 - 8. Provide supplemental sound-control treatment to isolate removal and dismantling work from other areas of the building.
 - 9. Protect adjacent surfaces and equipment by covering them with heavy polyethylene film and waterproof masking tape[**or a liquid strippable masking agent**]. If practical, remove items, store, and reinstall after potentially damaging operations are complete.
 - 10. Neutralize and collect alkaline and acid wastes for disposal off Owner's property.
 - 11. Dispose of debris and runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.
- C. Existing Drains: Prior to the start of work in an area, test drainage system to ensure that it is functioning properly. Notify Architect immediately of inadequate drainage or blockage. Do not begin work in an area until the drainage system is in working order.

1. Prevent solids such as aggregate or mortar residue from entering the drainage system. Clean out drains and drain lines that become sluggish or blocked by sand or other materials resulting from concrete maintenance work.
 2. Protect drains from pollutants. Block drains or filter out sediments, allowing only clean water to pass.
- D. Preparation for Concrete Removal: Examine construction to be repaired to determine best methods to safely and effectively perform concrete maintenance work. Examine adjacent work to determine what protective measures will be necessary. Make explorations, probes, and inquiries as necessary to determine condition of construction to be removed in the course of repair.
1. Verify that affected utilities have been disconnected and capped.
 2. Inventory and record the condition of items to be removed for reinstallation or salvage.
 3. Provide and maintain shoring, bracing, and temporary structural supports as required to preserve stability and prevent unexpected or uncontrolled movement, settlement, or collapse of construction being demolished and construction and finishes to remain. Strengthen or add new supports when required during progress of removal work.
- E. Reinforcing-Bar Preparation: Remove loose and flaking rust from exposed reinforcing bars by **[high-pressure water cleaning] [abrasive blast cleaning] [needle scaling] [or] [wire brushing]** until only tightly adhered light rust remains.
1. Where section loss of reinforcing bar is more than 25 percent, or 20 percent in two or more adjacent bars, cut bars and remove and replace as indicated on Drawings.
 2. Remove additional concrete as necessary to provide at least **3/4-inch** clearance at existing and replacement bars.
 3. Splice replacement bars to existing bars according to **ACI 318** by lapping, welding, or using mechanical couplings.
- F. Preparation of Floor Joints for Repair: Saw-cut joints full width to edges and depth of spalls, but not less than **[3/4 inch] [1 inch] [2 inches]** **<Insert dimension>** deep. Clean out debris and loose concrete; vacuum or blow clear with compressed air.
- G. Surface Preparation for Corrosion-Inhibiting Treatment: Clean concrete to remove dirt, oils, films, and other materials detrimental to treatment application.
1. Use **[low-pressure water cleaning] [detergent scrubbing] [or] [sand blasting]** **<Insert requirement>**.
 2. Allow surface to dry before applying corrosion-inhibiting treatment.
- H. Surface Preparation for Overlays:
1. Remove delaminated material and deteriorated concrete surface material.
 2. Roughen surface of concrete to produce a surface profile matching CSP **[3] [4] [5] [6] [7] [8] [9]** according to ICRI 310.2.
 3. Use **[sand blasting] [shot blasting] [scarifying] [needle scaling] [high-pressure water jetting] [scabbling] [flame blasting] [or] [milling]** **<Insert requirement>**.
 4. Sweep and vacuum roughened surface to remove debris **[followed by low-pressure water cleaning]**.
- I. Acidic Surface Preparation for Sealers: Acid etch surface of concrete to produce a surface profile matching CSP 1 according to ICRI 310.2. **[Prepare surface for acid etching by detergent scrubbing to remove oils and films that may prevent acid penetration.]**

1. Remove excess acid solution, reaction products, and debris by squeegeeing or vacuuming.
 2. Scrub surface with an alkaline detergent, rinse, and squeegee or vacuum.
 3. Check acidity of surface with pH test paper and continue rinsing until pH is acceptable according to sealer manufacturer's written instructions.
 4. When pH is acceptable according to sealer manufacturer's written instructions and surface is clean, vacuum dry.
- J. Nonacidic Surface Preparation for Sealers: Clean concrete to remove dirt, oils, films, and other materials detrimental to sealer application.
1. Use **[shot blasting]** **[low-pressure water cleaning]** **[or]** **[detergent scrubbing]** **<Insert requirement>**.
- K. Surface Preparation for Composite Structural Reinforcement: Clean concrete where reinforcement and epoxy patching mortar is to be placed by **[low-pressure water cleaning]** **[or]** **[detergent scrubbing]** **<Insert requirement>** to remove dirt, oils, films, and other materials detrimental to epoxy patching mortar.
1. Roughen surface of concrete by sand blasting.
 2. Remove delaminated material and deteriorated concrete surface material.
 3. Sweep and vacuum roughened surface to remove debris **[followed by low-pressure water cleaning]**.
- 3.5 REMOVAL OF CONCRETE
- A. Do not overload structural elements with debris.
- B. Saw-cut perimeter of areas indicated for removal to a depth of at least **[1/2 inch]** **<Insert dimension>**. Make cuts perpendicular to concrete surfaces and no deeper than cover on reinforcement.
- C. Remove deteriorated and delaminated concrete by breaking up and dislodging from reinforcement.
- D. Remove additional concrete if necessary to provide a depth of removal of at least **[1/2 inch]** **<Insert dimension>** over entire removal area.
- E. Where half or more of the perimeter of reinforcing bar is exposed, bond between reinforcing bar and surrounding concrete is broken, or reinforcing bar is corroded, remove concrete from entire perimeter of bar and to provide at least **3/4-inch** clearance around bar.
- F. Test areas where concrete has been removed by tapping with hammer, and remove additional concrete until unsound and disbonded concrete is completely removed.
- G. Provide surfaces with a fractured profile of at least **1/8 inch** that are approximately perpendicular or parallel to original concrete surfaces. At columns and walls, make top and bottom surfaces level unless otherwise directed.
- H. Thoroughly clean removal areas of loose concrete, dust, and debris.
- 3.6 APPLICATION OF BONDING AGENT
- A. Epoxy-Modified, Cementitious Bonding and Anticorrosion Agent: Apply to reinforcing bars

[**and concrete**] by stiff brush or hopper spray according to manufacturer's written instructions. Apply to reinforcing bars in two coats, allowing first coat to dry two to three hours before applying second coat. Allow to dry before placing patching mortar or concrete.

- B. Epoxy Bonding Agent: Apply to reinforcing bars[**and concrete**] by brush, roller, or spray according to manufacturer's written instructions, leaving no pinholes or other uncoated areas.[**Apply to reinforcing bars in at least two coats, allowing first coat to dry before applying second coat.**] Place patching mortar or concrete while epoxy is still tacky. If epoxy dries, recoat before placing patching mortar or concrete.
- C. Latex Bonding Agent, Type I: Apply to concrete by brush roller or spray. Allow to dry before placing patching mortar or concrete.
- D. Latex Bonding Agent, Type II: Mix with portland cement and scrub into concrete surface according to manufacturer's written instructions. Place patching mortar or concrete while bonding agent is still wet. If bonding agent dries, recoat before placing patching mortar or concrete.
- E. Mortar Scrub Coat for Job-Mixed Patching Mortar[**and Concrete**]: Dampen repair area and surrounding concrete **6 inches** beyond repair area. Remove standing water and apply scrub coat with a brush, scrubbing it into surface and thoroughly coating repair area. If scrub coat dries, recoat before placing patching mortar or concrete.
- F. Slurry Coat for Cementitious Patching Mortar: Wet substrate thoroughly and then remove standing water. Scrub a slurry of neat patching mortar[**mixed with latex bonding agent**] into substrate, filling pores and voids.

3.7 INSTALLATION OF DRY-PACK-MORTAR

- A. Use dry-pack mortar for deep cavities[**and where indicated**]. Place as specified in this article unless otherwise recommended in writing by manufacturer.
 - 1. Provide forms where necessary to confine patch to required shape.
 - 2. Wet substrate and forms thoroughly and then remove standing water.
- B. Pretreatment: Apply specified [**bonding agent**] [**mortar scrub coat**] [**slurry coat**] [**bonding agent and slurry coat**] <Insert requirement>.
- C. Place dry-pack mortar into cavity by hand, and compact tightly into place. Do not place more material at a time than can be properly compacted. Continue placing and compacting until patch is approximately level with surrounding surface.
- D. After cavity is filled and patch is compacted, trowel surface to match profile and finish of surrounding concrete. A thin coat of patching mortar may be troweled into the surface of patch to help obtain required finish.
- E. Wet-cure patch for not less than seven days by water-fog spray or water-saturated absorptive cover.

3.8 CONCRETE PLACEMENT

- A. Place concrete according to [**Section 033000 "Cast-in-Place Concrete"**] [**Section 033300 "Architectural Concrete"**] and as specified in this article.

- B. Epoxy-Modified Pretreatment: Apply [**epoxy-modified, cementitious bonding and anticorrosion agent**] [**epoxy bonding agent**] <Insert requirement> to reinforcement[**and concrete substrate**].
- C. Latex Pretreatment: Apply [**latex bonding agent**] [**Type I latex bonding agent**] [**mortar scrub coat**] <Insert requirement> to concrete substrate.
- D. Standard Placement: Place concrete by form-and-pump method unless otherwise indicated.
 - 1. Use vibrators to consolidate concrete as it is placed.
 - 2. At unformed surfaces, screed concrete to produce a surface that when finished with patching mortar will match required profile and surrounding concrete.
- E. Form-and-Pump Placement: Place concrete by form-and-pump method where indicated.
 - 1. Design and construct forms to resist pumping pressure in addition to weight of wet concrete. Seal joints and seams in forms and where forms abut existing concrete.
 - 2. Pump concrete into place from bottom to top, releasing air from forms as concrete is introduced. When formed space is full, close air vents and pressurize to **14 psi**.
- F. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
- G. Fill placement cavities with dry-pack mortar and repair voids with patching mortar. Finish to match surrounding concrete.

3.9 GROUTING PREPLACED AGGREGATE CONCRETE

- A. Use grouted preplaced aggregate concrete [**where indicated**] [**for column and wall repairs**] <Insert requirement>. Place as specified in this article.
- B. Design and construct forms to resist pumping pressure in addition to weight of wet grout. Seal joints and seams in forms and where forms abut existing concrete.
- C. Apply [**epoxy-modified cementitious bonding and anticorrosion agent**] [**epoxy bonding agent**] to reinforcement[**and concrete substrate**].
- D. Place aggregate in forms, consolidating aggregate in lifts as it is placed. Pack aggregate into upper areas of forms to achieve intimate contact with concrete surfaces.
- E. Fill forms with water to thoroughly dampen aggregate and substrates. Drain water from forms before placing grout.
- F. Pump grout into place at bottom of preplaced aggregate, forcing grout upward. Release air from forms at top as grout is introduced. When formed space is full and grout flows from air vents, close vents and pressurize to **14 psi**.
- G. Wet-cure concrete for not less than seven days by leaving forms in place or keeping surfaces continuously wet by water-fog spray or water-saturated absorptive cover.
- H. Repair voids with patching mortar and finish to match surrounding concrete.

3.10 FLOOR-JOINT REPAIR

- A. Cut out deteriorated concrete [**and reconstruct sides of joint with patching mortar**] <Insert **requirement**> as indicated on Drawings. Install joint filler in nonmoving floor joints where indicated and as specified in this article.
- B. Depth: Install joint filler to a depth of at least [**3/4 inch**] [**1 inch**] [**2 inches**] <Insert **dimension**>. Use fine silica sand no more than **1/4 inch** deep to close base of joint. Do not use sealant backer rods or compressible fillers below joint filler.
- C. Top Surface: Install joint filler so that when cured, it is flush at top surface of adjacent concrete. If necessary, overfill joint and remove excess when filler has cured.

3.11 EPOXY CRACK INJECTION

- A. Clean cracks with oil-free compressed air or low-pressure water to remove loose particles.
- B. Clean areas to receive capping adhesive of oil, dirt, and other substances that would interfere with bond.
- C. Place injection ports as recommended by epoxy manufacturer, spacing no farther apart than thickness of member being injected. Seal injection ports in place with capping adhesive.
- D. Seal cracks at exposed surfaces with a ribbon of capping adhesive at least **1/4 inch** thick by **1 inch** wider than crack.
- E. Inject cracks wider than **0.003 inch** to a depth of **8 inches**.
- F. Inject epoxy adhesive, beginning at widest part of crack and working toward narrower parts. Inject adhesive into ports to refusal, capping adjacent ports when they extrude epoxy. Cap injected ports and inject through adjacent ports until crack is filled.
- G. After epoxy adhesive has set, remove injection ports and grind surfaces smooth.

3.12 APPLICATION OF CORROSION-INHIBITING-TREATMENT

- A. Apply corrosion-inhibiting treatment to [**surfaces indicated on Drawings, from wall-to-wall or curb-to-curb and from joint-to-joint in the perpendicular direction**] <Insert **locations and extent where treatment shall be applied**>.
- B. Apply by brush, roller, or airless spray in two coats at manufacturer's recommended application rate. Remove film of excess treatment by high-pressure washing before patching treated concrete[**or applying a sealer or overlay**].

3.13 APPLICATION OF POLYMER OVERLAY

- A. Apply polymer overlay according to ACI 503.3.
- B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.14 APPLICATION OF POLYMER SEALER

- A. Apply polymer sealer by brush, roller, or airless spray at manufacturer's recommended application rate.

- B. Apply to traffic-bearing surfaces, including parking areas and walks.

3.15 INSTALLATION OF COMPOSITE STRUCTURAL REINFORCEMENT

- A. Fiber Tow Sheet and Saturant: Unless otherwise recommended by manufacturer, install as follows:
1. Apply epoxy primer using brush or short nap roller to prepared concrete surfaces in areas where composite structural reinforcement will be applied.
 2. After primer has set, patch surface defects with epoxy filler and allow to set before beginning reinforcement application.
 3. Apply epoxy saturant to **[fiber tow sheet]** **[or]** **[primed and patched surface]** using roller. Apply fiber tow sheet to primed and patched surface while saturant is still wet, using pressure roller to remove air pockets. Remove paper backing from fiber tow sheet and apply additional epoxy to fully saturate tow sheet.
 4. Apply additional layers using same procedure, fully saturating each layer with epoxy.
 5. After saturant has cured, apply protective topcoat by **[brush]** **[roller]** **[or]** **[spray]**.
- B. Preimpregnated Fiber Sheet: Unless otherwise recommended by manufacturer, install as follows:
1. Patch surface defects with epoxy mortar and allow to set before beginning reinforcement application.
 2. Apply epoxy adhesive to a thickness of **1/16 inch** to prepared concrete surfaces.
 3. Clean fiber sheet with acetone or other suitable solvent, and apply epoxy adhesive to a thickness of **1/16 inch**.
 4. Apply adhesive-coated fiber sheet to adhesive-coated concrete and roll with a hard rubber roller until fiber sheet is fully embedded in adhesive, air pockets are removed, and adhesive is forced out from beneath fiber sheet at edges.
 5. Apply additional layers using same procedure.

3.16 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. Packaged, Cementitious Patching Mortar: **<Insert number>** randomly selected sets of samples for each type of mortar required, tested according to ASTM C928/C928M.
 2. Job-Mixed Patching Mortar: **<Insert number>** randomly selected sets of samples for each type of mortar required, tested for compressive strength according to ASTM C109/C109M.
 3. Concrete: As specified in **[Section 033000 "Cast-in-Place Concrete."]** **[Section 033300 "Architectural Concrete."]**
 4. Grout for Preplaced Aggregate: Tested for compressive strength according to ASTM C942.
 - a. Testing Frequency: One sample for each **25 cu. yd.** of grout or fraction thereof, but not less than one sample for each day's work.
 5. Joint Filler: Core-drilled samples to verify proper installation.
 - a. Testing Frequency: One sample for each **100 feet** of joint filled.
 - b. Where samples are taken, refill holes with joint filler.
 6. Epoxy Crack Injection: Core-drilled samples to verify proper installation.
 - a. Testing Frequency: **[Three samples from mockup and]**one sample for each **100**

- ### 3.17 CONCRETE MAINTENANCE SCHEDULE

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7. Composite structural reinforcement of columns.

END OF SECTION 030130

SECTION 031000 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Form-facing material for cast-in-place concrete.
 - 2. Shoring, bracing, and anchoring.

1.2 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
 - 1. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction, movement, contraction, and isolation joints
 - c. Forms and form-removal limitations.
 - d. Shoring and reshoring procedures.
 - e. Anchor rod and anchorage device installation tolerances.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Forms for cylindrical columns.
 - 4. Pan-type forms.
 - 5. Void forms.
 - 6. Form liners.
 - 7. Insulating concrete forms.
 - 8. Form ties.
 - 9. Waterstops.
 - 10. Form-release agent.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Environmental Product Declaration (EPD): For each product.
 - 4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.

5. Environmental Product Declaration: For each product.
 6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
 7. Environmental Product Declaration: For each product.
 8. Environmental Product Declaration: For each product.
 9. Third-Party Certifications: For each product.
 10. Third-Party Certified Life Cycle Assessment: For each product.
 11. Laboratory Test Reports: For **[liquid floor treatments] [and] [curing and sealing compounds]**, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with **ACI 301**.
 - a. Location of construction joints is subject to approval of the Architect.
 3. Indicate location of waterstops.
 4. Indicate form liner layout and form line termination details.
 5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
 6. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.
- D. Samples:
1. For waterstops.
 2. For Form Liners: **12-inch by 12-inch** sample, indicating texture.
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For testing and inspection agency.
- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- C. Field quality-control reports.
- D. Minutes of preinstallation conference.
- 1.6 QUALITY ASSURANCE
- A. Testing and Inspection Agency Qualifications: An independent agency, **[acceptable to authorities having jurisdiction,]** qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
1. Build panel approximately **[100 sq. ft.]** **<Insert area>** in the location indicated or, if not indicated, as directed by Architect.
 2. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Form Liners: Store form liners under cover to protect from sunlight.
- B. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- C. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with **ACI 301**, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with **ACI 301**, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than [1/240] [1/360] [1/600] [1/720] <Insert ratio> of the wall height.

2.2 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than **0.022-inch** thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than **0.034 inch** thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, **3/4 by 3/4 inch**, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 1. Furnish units that leave no corrodible metal closer than **1 inch** to the plane of exposed concrete surface.
 2. Furnish ties that, when removed, leave holes no larger than **1 inch** in diameter in concrete surface.
 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with **ACI 301**.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of **ACI 117** and to comply with the Surface Finish designations specified in Section 033000 "Cast-In-Place Concrete" for as-cast finishes [and] [Section 033300 "Architectural Concrete"].
- C. Limit concrete surface irregularities as follows:
 1. Surface Finish-1.0: ACI 117 Class D, **1 inch**.
 2. Surface Finish-2.0: ACI 117 Class B, **1/4 inch**.
 3. Surface Finish-3.0: ACI 117 Class A, **1/8 inch**.
- D. Construct forms tight enough to prevent loss of concrete mortar.
 1. Minimize joints.
 2. Exposed Concrete: Symmetrically align joints in forms.
- E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- F. Do not use rust-stained, steel, form-facing material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 1. Provide and secure units to support screed strips
 2. Use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 2. Locate temporary openings in forms at inconspicuous locations.
- I. [**Chamfer**] [**Do not chamfer**] exterior corners and edges of permanently exposed concrete.

- J. At construction joints, overlap forms onto previously placed concrete not less than **12 inches**.
- K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- L. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls [**as indicated on Drawings**] **<Insert spacing>**.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- P. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.

5. Clean embedded items immediately prior to concrete placement.

3.3 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than **50 deg F** for [24] <Insert number> hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.
 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved[**at least 70 percent of**] its 28-day design compressive strength.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
 1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
 1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORING AND RESHORING INSTALLATION

- A. Comply with **ACI 318** and **ACI 301** for design, installation, and removal of shoring and reshoring.
 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.
- C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a [special inspector] [and] [qualified testing and inspecting agency] to perform field tests and inspections and prepare test reports.
- B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- C. Inspections:
 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 031000

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 033300 "Architectural Concrete" for general building applications of specially finished formed concrete.
4. Section 033543 "Polished Concrete Finishing" for concrete floors scheduled to receive a polished concrete finish.
5. Section 035300 "Concrete Topping" for emery- and iron-aggregate concrete floor toppings.
6. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
7. Section 321313 "Concrete Paving" for concrete pavement and walks.
8. Section 321316 "Decorative Concrete Paving" for decorative concrete pavement and walks.

1.2 DEFINITIONS

- A. Cementitious Materials:** Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

- B. Water/Cement Ratio (w/cm):** The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

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

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Special concrete finish Subcontractor.
2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Construction joints, control joints, isolation joints, and joint-filler strips.
 - c. Semirigid joint fillers.
 - d. Vapor-retarder installation.
 - e. Anchor rod and anchorage device installation tolerances.
 - f. Cold and hot weather concreting procedures.
 - g. Concrete finishes and finishing.

- h. Curing procedures.
- i. Forms and form-removal limitations.
- j. Shoring and reshoring procedures.
- k. Methods for achieving specified floor and slab flatness and levelness.
- l. Floor and slab flatness and levelness measurements.
- m. Concrete repair procedures.
- n. Concrete protection.
- o. Initial curing and field curing of field test cylinders (ASTM C31/C31M.)
- p. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Fly ash.
- 3. Slag cement.
- 4. Blended hydraulic cement.
- 5. Silica fume.
- 6. Performance-based hydraulic cement
- 7. Aggregates.
- 8. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 9. Color pigments.
- 10. Fiber reinforcement.
- 11. Vapor retarders.
- 12. Floor and slab treatments.
- 13. Liquid floor treatments.
- 14. Curing materials.
 - a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
- 15. Joint fillers.
- 16. Repair materials.

B. Sustainable Design Submittals:

- 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
- 3. Environmental Product Declaration (EPD): For each product.
- 4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
- 5. Environmental Product Declaration: For each product.
- 6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.

7. Environmental Product Declaration: For each product.
 8. Environmental Product Declaration: For each product.
 9. Third-Party Certifications: For each product.
 10. Third-Party Certified Life Cycle Assessment: For each product.
 11. Laboratory Test Reports: For **[liquid floor treatments] [and] [curing and sealing compounds]**, indicating compliance with requirements for low-emitting materials.
 12. Health Product Declaration (HPD): Provide documentation confirming product compliance with one of the following:
 - a. Inventory or HPD to at least 0.01 percent by weight with no GreenScreen LT-1 or GHS Category 1 hazards.
 - b. Inventory or HPD to at least 0.01 percent by weight, with at least 75 percent assessed using GreenScreen Benchmark assessment.
 - c. Third-party-verified Declare product label, designated "Red List Free."
 - d. Material Health Certificate or Cradle to Cradle certification with minimum Bronze level of Material Health.
- C. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
 2. Minimum 28-day compressive strength.
 3. Durability exposure class.
 4. Maximum w/cm.
 5. Calculated equilibrium unit weight, for lightweight concrete.
 6. Slump limit.
 7. Air content.
 8. Nominal maximum aggregate size.
 9. Steel-fiber reinforcement content.
 10. Synthetic micro-fiber content.
 11. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
 12. Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.
 13. Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.
 14. Intended placement method.
 15. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- D. Shop Drawings:
1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- E. Samples: For **[manufacturer's standard colors for color pigment] [vapor retarder] <Insert products>**.
- F. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
1. Concrete Class designation.
 2. Location within Project.
 3. Exposure Class designation.

4. Formed Surface Finish designation and final finish.
5. Final finish for floors.
6. Curing process.
7. Floor treatment if any.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Installer: Include copies of applicable ACI certificates.
 2. Ready-mixed concrete manufacturer.
 3. Testing agency: Include copies of applicable ACI certificates.
- B. Material Certificates: For each of the following, signed by manufacturers:
1. Cementitious materials.
 2. Admixtures.
 3. Fiber reinforcement.
 4. Curing compounds.
 5. Floor and slab treatments.
 6. Bonding agents.
 7. Adhesives.
 8. Vapor retarders.
 9. Semirigid joint filler.
 10. Joint-filler strips.
 11. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
1. Portland cement.
 2. Fly ash.
 3. Slag cement.
 4. Blended hydraulic cement.
 5. Silica fume.
 6. Performance-based hydraulic cement.
 7. Aggregates.
 8. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 2. For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.
- H. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician [**with experience installing and finishing concrete, incorporating permeability-reducing admixtures**].
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor to be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality-Control Testing Agency Qualifications: An independent agency, [**acceptable to authorities having jurisdiction,**] qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.
- E. Mockups: Cast concrete [**slab-on-ground**] [**and**] [**formed-surface**] panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship.
 - 1. Slab-On-Ground: Build panel approximately **15 feet by 15 feet** <Insert area> in the location indicated or, if not indicated, as directed by Architect.
 - a. Divide panel into four equal panels to demonstrate saw joint cutting.
 - 2. Formed Surfaces: Build panel approximately **100 sq. ft.** <Insert area> in the location indicated or, if not indicated, as directed by Architect.
 - 3. 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 Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. Seven-day compressive strength.
 - e. 28-day compressive strength.
 - f. Permeability.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94/C94M and **ACI 301**.

1.9 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with **ACI 301** and ACI 306.1 and as follows.
1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 2. When average high and low temperature is expected to fall below **40 deg F** for three successive days, maintain delivered concrete mixture temperature within the temperature range required by **ACI 301**.
 3. Do not use frozen materials or materials containing ice or snow.
 4. Do not place concrete in contact with surfaces less than **35 deg F**, other than reinforcing steel.
 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with **ACI 301** and **ACI 305.1**, and as follows:
1. Maintain concrete temperature at time of discharge to not exceed **95 deg F**.
 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.
1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with **ACI 301** unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Regional Materials: Concrete shall be manufactured within **500 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.
- B. Regional Materials: Concrete shall be manufactured within **500 miles** of Project site.
- C. Regional Materials: Concrete shall be manufactured within **100 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **100 miles** of Project site.
- D. Indigenous Materials: Concrete shall be manufactured within **500 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.

- E. Regional Materials: Concrete shall be manufactured within **500 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- F. Source Limitations:
1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 3. Obtain aggregate from single source.
 4. Obtain each type of admixture from single source from single manufacturer.
- G. Cementitious Materials:
1. Portland Cement: ASTM C150/C150M, [Type I] [Type II] [Type I/II] [Type III] [Type V], [gray] [white].
 2. Fly Ash: ASTM C618, Class C or F.
 3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
 4. Blended Hydraulic Cement: ASTM C595/C595M, [Type IS, portland blast-furnace slag] [Type IP, portland-pozzolan] [Type IL, portland-limestone] [Type IT, ternary blended] cement.
 5. Silica Fume: ASTM C1240 amorphous silica.
 6. Performance-Based Hydraulic Cement: ASTM C1157/C1157M: [Type GU, general use] [Type HE, high early strength] [Type MS, moderate sulfate resistance] [Type HS, high sulfate resistance] [Type MH, moderate heat of hydration] [Type LH, low heat of hydration].
- H. Normal-Weight Aggregates: ASTM C33/C33M, [Class 3S] [Class 3M] [Class 1N] <Insert class> coarse aggregate or better, graded. Provide aggregates from a single source.
1. Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
 - b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than **4 lb./cu. yd.** for moderately reactive aggregate or **3 lb./cu. yd.** for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with **ACI 301**.
 2. Maximum Coarse-Aggregate Size: [**1-1/2 inches**] [**1 inch**] [**3/4 inch**] <Insert dimension> nominal.
 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- I. Lightweight Aggregate: ASTM C330/C330M, [**1-inch**] [**3/4-inch**] [**1/2-inch**] [**3/8-inch**] nominal maximum aggregate size.
- J. Water and Water Used to Make Ice: ASTM C94/C94M, potable [or] [complying with **ASTM C1602/C1602M, including all limits listed in Table 2 and the requirements of paragraph 5.4**]

2.3 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/8 inch** and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than **[4100 psi]** **<Insert strength>** at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from **1/4 inch** and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, **1/8 to 1/4 inch** or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than **[5000 psi]** **<Insert strength>** at 28 days when tested in accordance with ASTM C109/C109M.

2.4 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with **ACI 301**.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash or Other Pozzolans: 25 percent by mass.
 - 2. Slag Cement: 50 percent by mass.
 - 3. Silica Fume: 10 percent by mass.
 - 4. Total of Fly Ash or Other Pozzolans, Slag Cement, and Silica Fume: 50 percent by mass, with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
 - 5. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.
- C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
 - 1. Use **[water-reducing]** **[high-range water-reducing]** **[or]** **[plasticizing]** admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in **[pumped concrete,]** **[concrete for heavy-use**

industrial slabs] [concrete for parking structure slabs,] [and] [concrete with a w/cm below 0.50].

4. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
5. Use permeability-reducing admixture in concrete mixtures where indicated.

D. Color: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.5 CONCRETE MIXTURES

A. Class [A] <Insert designation>: Normal-weight concrete used for footings, grade beams, and tie beams.

1. Exposure Class: **ACI 318** [F0] [F1] [F2] [F3] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
2. Minimum Compressive Strength: **[5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi]** [As indicated] <Insert strength> at 28 days.
3. Maximum w/cm: **[0.50] [0.45] [0.40]** <Insert number>.
4. Slump Limit: **[4 inches, plus or minus 1 inch] [5 inches, plus or minus 1 inch] [8 inches, plus or minus 1 inch]** for concrete with verified slump of **3 inches** plus or minus **1 inch** before adding high-range water-reducing admixture or plasticizing admixture at Project site] <Insert limits>.
5. Slump Flow Limit: **[22 inches, plus or minus 1.5 inches] [30 inches, plus or minus 2.5 inches]** <Insert limits>.
6. Air Content:
 - a. Exposure Class F1: [5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
 - b. Exposure Classes F2 and F3: [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
7. Limit water-soluble, chloride-ion content in hardened concrete to **[1.00] [0.30] [0.15]** <Insert number> percent by weight of cement.

B. Class [B] <Insert designation>: Normal-weight concrete used for foundation walls.

1. Exposure Class: **ACI 318** [F0] [F1] [F2] [F3] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
2. Minimum Compressive Strength: **[5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi]** [As indicated] <Insert strength> at 28 days.
3. Maximum w/cm: **[0.50] [0.45] [0.40]** <Insert number>.
4. Slump Limit: **[4 inches, plus or minus 1 inch] [5 inches, plus or minus 1 inch] [8 inches, plus or minus 1 inch]** for concrete with verified slump of **3 inches**, plus or minus **1 inch**, before adding high-range water-reducing admixture or plasticizing admixture at Project site] <Insert limits>.
5. Slump Flow Limit: **[22 inches, plus or minus 1.5 inches] [30 inches, plus or minus 2.5 inches]** <Insert limits>.

6. Air Content:
 - a. Exposure Class F1: [5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
 - b. Exposure Classes F2 and F3: [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
 7. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] **<Insert number>** percent by weight of cement.
- C. Class [C] **<Insert designation>**: Normal-weight concrete used for interior slabs-on-ground.
1. Exposure Class: **ACI 318** [F0] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
 2. Minimum Compressive Strength: [5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi] [As indicated] **<Insert strength>** at 28 days.
 3. Maximum w/cm: [0.50] [0.45] [0.40] **<Insert number>**.
 4. Minimum Cementitious Materials Content: [470 lb/cu. yd.] [520 lb/cu. yd.] [540 lb/cu. yd.] [610 lb/cu. yd.].
 5. Slump Limit: [4 inches, plus or minus 1 inch] [5 inches, plus or minus 1 inch] [8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site] **<Insert limits>**.
 6. Slump Flow Limit: [22 inches, plus or minus 1.5 inches] [30 inches, plus or minus 2.5 inches] **<Insert limits>**.
 7. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 8. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] **<Insert number>** percent by weight of cement.
 9. Steel-Fiber Reinforcement: Add to concrete mixture, in accordance with manufacturer's written instructions, at a rate of [50 lb/cu. yd.] **<Insert weight>**.
 10. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [1.0 lb/cu. yd.] [1.5 lb/cu. yd.] **<Insert dosage>**.
 11. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [4.0 lb/cu. yd.] [5 lb/cu. yd.] **<Insert dosage>**.
- D. Class [D] **<Insert designation>**: Normal-weight concrete used for interior suspended slabs.
1. Exposure Class: **ACI 318** [F0] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
 2. Minimum Compressive Strength: [5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi] **<Insert strength>** [As indicated] at 28 days.
 3. Maximum w/cm: [0.50] [0.45] [0.40] **<Insert number>**.
 4. Minimum Cementitious Materials Content: [470 lb/cu. yd.] [520 lb/cu. yd.] [540 lb/cu. yd.]

- yd.] [610 lb/cu. yd.].
5. Slump Limit: [4 inches, plus or minus 1 inch] [5 inches, plus or minus 1 inch] [8 inches, plus or minus 1 inch] for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site] <Insert limits>.
 6. Slump Flow Limit: [22 inches, plus or minus 1.5 inches] [30 inches, plus or minus 2.5 inches] <Insert limits>.
 7. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 8. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] <Insert number> percent by weight of cement.
 9. Steel-Fiber Reinforcement: Add to concrete mixture, in accordance with manufacturer's written instructions, at a rate of [50 lb/cu. yd.] <Insert weight>.
 10. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [1.0 lb/cu. yd.] [1.5 lb/cu. yd.] <Insert dosage>.
 11. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [4.0 lb/cu. yd.] [5 lb/cu. yd.] <Insert dosage>.
- E. Class [E] <Insert designation>: Structural lightweight concrete used for interior suspended slabs.
1. Exposure Class: ACI 318 [F0] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
 2. Minimum Compressive Strength: [5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi] <Insert strength> [As indicated] at 28 days.
 3. Calculated Equilibrium Unit Weight: [115 lb/cu. ft.] [110 lb/cu. ft.] [105 lb/cu. ft.], plus or minus 3 lb/cu. ft. as determined by ASTM C567/C567M.
 4. Slump Limit: [4 inches, plus or minus 1 inch] [5 inches, plus or minus 1 inch] [8 inches, plus or minus 1 inch] for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site] <Insert limits>.
 5. Slump Flow Limit: [22 inches, plus or minus 1.5 inches] [30 inches, plus or minus 2.5 inches] <Insert limits>.
 6. Air Content:
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.
 7. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] <Insert number> percent by weight of cement.
 8. Steel-Fiber Reinforcement: Add to concrete mixture, in accordance with manufacturer's written instructions, at a rate of [50 lb/cu. yd.] <Insert weight>.
 9. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [1.0 lb/cu. yd.] [1.5 lb/cu. yd.] <Insert dosage>.
 10. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [4.0 lb/cu. yd.] [5 lb/cu. yd.] <Insert dosage>.
- F. Class [F] <Insert designation>: Normal-weight concrete used for concrete toppings.

1. Exposure Class: **ACI 318** [F0] [F1] [F2] [F3] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
 2. Minimum Compressive Strength: [5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi] <Insert strength> [As indicated] at 28 days.
 3. Minimum Cementitious Materials Content: [470 lb/cu. yd.] [520 lb/cu. yd.] [540 lb/cu. yd.].
 4. Slump Limit: [4 inches] [5 inches], plus or minus 1 inch.
 5. Air Content:
 - a. Exposure Class F1: [5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-1/2-inch nominal maximum aggregate size].
 - b. Exposure Classes F2 and F3: [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size] [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size] [5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-1/2-inch nominal maximum aggregate size].
 6. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] <Insert number> percent by weight of cement.
 - a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished toppings.
 7. Steel-Fiber Reinforcement: Add to concrete mixture, in accordance with manufacturer's written instructions, at a rate of [50 lb/cu. yd.] <Insert weight>.
 8. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [1.0 lb/cu. yd.] [1.5 lb/cu. yd.] <Insert dosage>.
 9. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of [4.0 lb/cu. yd.] [5 lb/cu. yd.] <Insert dosage>.
- G. Class [G] <Insert designation>: Normal-weight concrete used for building frame members.
1. Exposure Class: **ACI 318** [F0] [F1] [F2] [F3] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
 2. Minimum Compressive Strength: [5000 psi] [4500 psi] [4000 psi] [3500 psi] [3000 psi] <Insert strength> [As indicated] at 28 days.
 3. Maximum w/cm: [0.50] [0.45] [0.40] <Insert number>.
 4. Slump Limit: [4 inches, plus or minus 1 inch] [5 inches, plus or minus 1 inch] [8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, plus or minus 1 inch, before adding high-range water-reducing admixture or plasticizing admixture at Project site] <Insert limits>.
 5. Slump Flow Limit: [22 inches, plus or minus 1.5 inches] [30 inches, plus or minus 2.5 inches] <Insert limits>.
 6. Air Content:
 - a. Exposure Class F1: [5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 3/4-inch nominal maximum aggregate size] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch

- nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
- b. Exposure Classes F2 and F3: [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
7. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] **<Insert number>** percent by weight of cement.
- H. Class [H] **<Insert designation>**: Normal-weight concrete used for building walls.
1. Exposure Class: **ACI 318** [F0] [F1] [F2] [F3] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
2. Minimum Compressive Strength: [**5000 psi**] [**4500 psi**] [**4000 psi**] [**3500 psi**] [**3000 psi**] **<Insert strength>** [As indicated] at 28 days.
3. Maximum w/cm: [0.50] [0.45] [0.40] **<Insert number>**.
4. Slump Limit: [**4 inches, plus or minus 1 inch**] [**5 inches, plus or minus 1 inch**] [**8 inches, plus or minus 1 inch** for concrete with verified slump of **3 inches, plus or minus 1 inch**, before adding high-range water-reducing admixture or plasticizing admixture at Project site] **<Insert limits>**.
5. Slump Flow Limit: [**22 inches, plus or minus 1.5 inches**] [**30 inches, plus or minus 2.5 inches**] **<Insert limits>**.
6. Air Content:
- a. Exposure Class F1: [5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
- b. Exposure Classes F2 and F3: [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
7. Limit water-soluble, chloride-ion content in hardened concrete to [1.00] [0.30] [0.15] **<Insert number>** percent by weight of cement.
- I. Class [I] **<Insert designation>**: Normal-weight concrete used for interior metal pan stairs and landings:
1. Exposure Class: **ACI 318** [F0] [F1] [F2] [F3] [S0] [S1] [S2] [S3] [W0] [W1] [C0] [C1] [C2].
2. Minimum Compressive Strength: [**3000 psi**] **<Insert strength>** [As indicated] at 28 days.
3. Maximum w/cm: [0.53] [0.45] [0.40] **<Insert number>**.
4. Minimum Cementitious Materials Content: **470 lb/cu. yd.**
5. Maximum Size Aggregate: **1/2 inch**.

6. Slump Limit: **3 inches**, plus **1 inch** or minus **2 inches**.
 7. Air Content: **[0]** **<Insert number>** percent, plus or minus 0.5 percent at point of delivery.
 8. Limit water-soluble, chloride-ion content in hardened concrete to **[1.00]** **[0.30]** **[0.15]** **<Insert number>** percent by weight of cement.
 9. Retarding Admixture: Not allowed.
 10. Accelerating Admixture: Not allowed.
- J. Class **[J]** **<Insert designation>**: Normal-weight concrete used for exterior retaining walls.
1. Exposure Class: **ACI 318** **[F0]** **[F1]** **[F2]** **[F3]** **[S0]** **[S1]** **[S2]** **[S3]** **[W0]** **[W1]** **[C0]** **[C1]** **[C2]**.
 2. Minimum Compressive Strength: **[5000 psi]** **[4500 psi]** **[4000 psi]** **[3500 psi]** **[3000 psi]** **<Insert strength>** **[As indicated]** at 28 days.
 3. Maximum w/cm: **[0.50]** **[0.45]** **[0.40]** **<Insert number>**.
 4. Slump Limit: **[4 inches, plus or minus 1 inch]** **[5 inches, plus or minus 1 inch]** **[8 inches, plus or minus 1 inch]** for concrete with verified slump of **3 inches**, plus or minus **1 inch**, before adding high-range water-reducing admixture or plasticizing admixture at Project site **<Insert limits>**.
 5. Slump Flow Limit: **[22 inches, plus or minus 1.5 inches]** **[30 inches, plus or minus 2.5 inches]** **<Insert limits>**.
 6. Air Content:
 - a. Exposure Class F1: [5.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
 - b. Exposure Classes F2 and F3: [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **3/4-inch nominal maximum aggregate size**] [6 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-inch nominal maximum aggregate size**] [5.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing **1-1/2-inch nominal maximum aggregate size**].
 7. Limit water-soluble, chloride-ion content in hardened concrete to **[1.00]** **[0.30]** **[0.15]** **<Insert number>** percent by weight of cement.
- 2.6 CONCRETE MIXING
- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M[**and ASTM C1116/C1116M**], and furnish batch ticket information.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For mixer capacity of **1 cu. yd.** or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
 2. For mixer capacity larger than **1 cu. yd.**, increase mixing time by 15 seconds for each additional **1 cu. yd.**.
 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:
 - 1. Daily access to the Work.
 - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 - 3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
 - 4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 INSTALLATION OF VAPOR RETARDER

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.
 - 1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
 - 2. Face laps away from exposed direction of concrete pour.
 - 3. Lap vapor retarder over footings and grade beams not less than **6 inches**, sealing vapor retarder to concrete.
 - 4. Lap joints **6 inches** and seal with manufacturer's recommended tape.
 - 5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
 - 6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
 - 7. Protect vapor retarder during placement of reinforcement and concrete.
 - a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by **6 inches** on all sides, and sealing to vapor retarder.
- B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder in accordance with manufacturer's written instructions.

3.5 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
 - 1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 - 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 3. Form keyed joints as indicated. Embed keys at least **1-1/2 inches** into concrete.
 - 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls [**as indicated on Drawings**] **<Insert spacing>**. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least [**one-fourth**] **<Insert depth>** of concrete thickness as follows:
 - 1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of **1/8 inch**. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch-** wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.
- D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than **1/2 inch** or more than **1 inch** below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

- F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of **ACI 301**, but not to exceed the amount indicated on the concrete delivery ticket.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- E. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
1. If a section cannot be placed continuously, provide construction joints as indicated.
 2. Deposit concrete to avoid segregation.
 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with **ACI 301**.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least **6 inches** into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- F. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Do not place concrete floors and slabs in a checkerboard sequence.
 2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 3. Maintain reinforcement in position on chairs during concrete placement.
 4. Screed slab surfaces with a straightedge and strike off to correct elevations.
 5. Level concrete, cut high areas, and fill low areas.

6. Slope surfaces uniformly to drains where required.
 7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
 8. Do not further disturb slab surfaces before starting finishing operations.
- 3.7 FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. **ACI 301** Surface Finish SF-1.0: As-cast concrete texture imparted by form-facing material.
 - a. Patch voids larger than **1-1/2 inches** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1 inch**.
 - c. Tie holes do not require patching.
 - d. Surface Tolerance: **ACI 117** Class D.
 - e. Apply to concrete surfaces [**not exposed to public view**] **<Insert locations>**.
2. **ACI 301** Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.
 - a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1/4 inch**.
 - c. Patch tie holes.
 - d. Surface Tolerance: **ACI 117** Class B.
 - e. Locations: Apply to concrete surfaces [**exposed to public view,**] [**to receive a rubbed finish,**] [**or to be covered with a coating or covering material applied directly to concrete**] **<Insert locations>**.
3. **ACI 301** Surface Finish SF-3.0:
 - a. Patch voids larger than **3/4 inch** wide or **1/2 inch** deep.
 - b. Remove projections larger than **1/8 inch**.
 - c. Patch tie holes.
 - d. Surface Tolerance: **ACI 117** Class A.
 - e. Locations: Apply to concrete surfaces [**exposed to public view,**] [**to receive a rubbed finish,**] [**or to be covered with a coating or covering material applied directly to concrete**] **<Insert locations>**.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish:
 - a. Perform no later than one day after form removal.
 - b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.
 - c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
 - d. Maintain required patterns or variances as shown on Drawings or to match [**design reference sample**] [**field sample panels**] [**mockups**].
2. Grout-Cleaned Rubbed Finish:
 - a. Clean concrete surfaces after contiguous surfaces are completed and accessible.
 - b. Do not clean concrete surfaces as Work progresses.
 - c. Mix 1 part portland cement to 1-1/2 parts fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.

- d. Wet concrete surfaces.
 - e. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap, and keep surface damp by fog spray for at least 36 hours.
 - f. Maintain required patterns or variances as shown on Drawings or to match [**design reference sample**] [**field sample panels**] [**mockups**].
3. Cork-Floated Finish:
- a. Mix 1 part portland cement to 1 part fine sand, complying with ASTM C144 or ASTM C404, by volume, with sufficient water to produce a mixture with the consistency of thick paint.
 - b. Mix 1 part portland cement and 1 part fine sand with sufficient water to produce a mixture of stiff grout. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces.
 - c. Wet concrete surfaces.
 - d. Compress grout into voids by grinding surface.
 - e. In a swirling motion, finish surface with a cork float.
 - f. Maintain required patterns or variances as shown on Drawings or to match [**design reference sample**] [**field sample panels**] [**mockups**].
4. Scrubbed Finish: After concrete has achieved a compressive strength of from **1000 to 1500 psi**, apply scrubbed finish.
- a. Wet concrete surfaces thoroughly and scrub with stiff fiber or wire brushes, using water freely, until top mortar surface is removed and aggregate is uniformly exposed.
 - b. Rinse scrubbed surfaces with clean water.
 - c. Maintain continuity of finish on each surface or area of Work.
 - d. Remove only enough concrete mortar from surfaces to match [**design reference sample**] [**field sample panels**] [**mockups**].
- C. Abrasive-Blast Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
- 1. Perform abrasive blasting after compressive strength of concrete exceeds **2000 psi**.
 - 2. Coordinate with formwork removal to ensure that surfaces to be abrasive blasted are treated at the same age.
 - 3. Surface Continuity:
 - a. Perform abrasive-blast finishing as continuous operation, maintaining continuity of finish on each surface or area of Work.
 - b. Maintain required patterns or variances in depths of blast to match [**design reference sample**] [**field sample panels**] [**mockups**].
 - 4. Abrasive Blasting:
 - a. Abrasive-blast corners and edges of patterns carefully, using backup boards to maintain uniform corner and edge lines.
 - b. Determine type of nozzle pressure and blasting techniques required to match field sample.
 - c. Depth of Cut: Use an abrasive grit of proper type and gradation to expose aggregate and surrounding matrix surfaces to match field sample, as follows:
 - 1) Brush Texture: Remove cement matrix to dull surface sheen and expose face of fine aggregate, with no significant reveal.
 - 2) Light Texture: Expose fine aggregate with occasional exposure of coarse aggregate and uniform color, with maximum reveal of **1/16 inch**.
 - 3) Medium Texture: Generally, expose coarse aggregate with slight reveal and

- with a maximum reveal of **1/4 inch**.
 - 4) Heavy Texture: Expose and reveal coarse aggregate to a maximum projection of one-third its diameter, with reveal range of **1/4 to 1/2 inch**.
 - d. Maintain required patterns or variances in reveal projection to match [**design reference sample**] [**field sample panels**] [**mockups**].
- D. High-Pressure Water-Jet Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
- 1. Perform high-pressure water jetting on concrete that has achieved a minimum compressive strength of **4500 psi**.
 - 2. Coordinate with formwork removal to ensure that surfaces to be high-pressure water-jet finished are treated at same age for uniform results.
 - 3. Surface Continuity: Perform high-pressure water-jet finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 - 4. Maintain required patterns or variances in reveal projection to match [**design reference sample**] [**field sample panels**] [**mockups**].
- E. Bushhammer Finish: Apply the following to as-cast surface finishes where indicated on Drawings:
- 1. Perform bushhammer finish to concrete that has achieved a minimum compressive strength of **4500 psi**.
 - 2. Surface Continuity:
 - a. Perform bushhammer finishing in as continuous an operation as possible, maintaining continuity of finish on each surface or area of Work.
 - 3. Surface Cut:
 - a. Maintain required depth of cut and general aggregate exposure.
 - b. Use power tool with hammer attachments for large, flat surfaces, and use hand hammers for small areas, at corners and edges, and for restricted locations where power tools cannot reach.
 - 4. Remove impressions of formwork and form facings with exception of tie holes.
 - 5. Maintain required patterns or variances of cut as shown on Drawings or to match [**design reference sample**] [**field sample panels**] [**mockups**].
 - 6. Maintain control of concrete chips, dust, and debris in each Work area, limiting migration of airborne materials and dust by use of tarpaulins, wind-breaks, or similar devices.
- F. Related Unformed Surfaces:
- 1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
 - 2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.
- 3.8 FINISHING FLOORS AND SLABS
- A. Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish:
- 1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
 - 2. Use stiff brushes, brooms, or rakes to produce a profile depth of **1/4 inch** in one direction.

3. Apply scratch finish to surfaces **[to receive concrete floor toppings] [to receive mortar setting beds for bonded cementitious floor finishes]** <Insert locations>.
- C. Float Finish:
1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
 2. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture and complies with **ACI 117** tolerances for conventional concrete.
 3. Apply float finish to surfaces **[to receive trowel finish] [and] [to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo]** <Insert locations>.
- D. Trowel Finish:
1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.
 2. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance.
 3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 4. Do not add water to concrete surface.
 5. Do not apply hard-troweled finish to concrete, which has a total air content greater than 3 percent.
 6. Apply a trowel finish to surfaces **[exposed to view] [or] [to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system]** <Insert locations>.
 7. Finish surfaces to the following tolerances, in accordance with **ASTM E1155**, for a randomly trafficked floor surface:
 - a. Slabs on Ground:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, **10-ft.-** long straightedge resting on two high spots and placed anywhere on the surface does not exceed **[1/4 inch] [3/16 inch] [1/8 inch] [1/8 inch and also no more than 1/16 inch in 2 feet]**.
 - 2) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.
 - 3) Specified overall values of flatness, FF 35; and of levelness, FL 25; with minimum local values of flatness, FF 24; and of levelness, FL 17.
 - 4) Specified overall values of flatness, FF 45; and of levelness, FL 35; with minimum local values of flatness, FF 30; and of levelness, FL 24.
 - 5) Specified overall values of flatness, FF 50; and of levelness, FL 25; with minimum local values of flatness, FF 40; and of levelness, FL 17.
 - b. Suspended Slabs:
 - 1) Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, **10-ft.-** long straightedge resting on two high spots and placed anywhere on the surface does not exceed **[1/4 inch] [3/16 inch] [1/8 inch] [1/8 inch and also no more than 1/16 inch in 2 feet]**.
 - 2) Specified overall values of flatness, FF 25; and of levelness, FL 20; with minimum local values of flatness, FF 17; and of levelness, FL 15.
 - 3) Specified overall values of flatness, FF 35; and of levelness, FL 20; with

- 4) minimum local values of flatness, FF 24; and of levelness, FL 15.
Specified overall values of flatness, FF 45; and of levelness, FL 35; with minimum local values of flatness, FF 30; and of levelness, FL 24.
 - E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces [**indicated on Drawings**] [**where ceramic or quarry tile is to be installed by either thickset or thinset method**]. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
 1. Coordinate required final finish with Architect before application.
 2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.
 - F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
 2. Coordinate required final finish with Architect before application.
 - G. Slip-Resistive Finish: Before final floating, apply slip-resistive [**aggregate**] [**aluminum granule**] finish to concrete stair treads, platforms, ramps as indicated on Drawings
 1. Apply in accordance with manufacturer's written instructions and as follows:
 - a. Uniformly spread [**25 lb/100 sq. ft.**] <Insert rate> of dampened slip-resistive [**aggregate**] [**aluminum granules**] over surface in one or two applications.
 - b. Tamp aggregate flush with surface, but do not force below surface.
 - c. After broadcasting and tamping, apply float finish.
 - d. After curing, lightly work surface with a steel wire brush or an abrasive stone and water to expose slip-resistive [**aggregate**] [**aluminum granules**].
 - H. Dry-Shake Floor Hardener Finish: After initial floating, apply dry-shake floor hardener to surfaces in accordance with manufacturer's written instructions and as follows:
 1. Uniformly apply dry-shake floor hardener at a rate of [**100 lb/100 sq. ft.**] <Insert rate> unless greater amount is recommended by manufacturer.
 2. Uniformly distribute approximately two-thirds of dry-shake floor hardener over surface by hand or with mechanical spreader, and embed by power floating.
 3. Follow power floating with a second dry-shake floor hardener application, uniformly distributing remainder of material, and embed by power floating.
 4. After final floating, apply a trowel finish.
 5. Cure concrete with curing compound recommended by dry-shake floor hardener manufacturer and apply immediately after final finishing.
- 3.9 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS
- A. Filling In:
 1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
 2. Mix, place, and cure concrete, as specified, to blend with in-place construction.
 3. Provide other miscellaneous concrete filling indicated or required to complete the Work.
 - B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases [**4 inches**] [**6 inches**] [**8 inches**] **<Insert dimension>** high unless otherwise indicated on Drawings, and extend base not less than **6 inches** in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: [**5000 psi**] [**4500 psi**] [**4000 psi**] [**3500 psi**] [**3000 psi**] **<Insert value>** at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch** centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.
 - a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - b. Cast anchor-bolt insert into bases.
 - c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.10 CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with **ACI 301** and ACI 306.1 for cold weather protection during curing.
2. Comply with **ACI 301** and **ACI 305.1** for hot-weather protection during curing.
3. Maintain moisture loss no more than **0.2 lb/sq. ft. x h** before and during finishing operations.

B. Curing Formed Surfaces: Comply with **ACI 308.1** as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period, as follows:
 - a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
 - b. Continuous Sprinkling: Maintain concrete surface continuously wet.
 - c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
 - d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
 - e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 1) Recoat areas subject to heavy rainfall within three hours after initial

- application.
 - 2) Maintain continuity of coating and repair damage during curing period.
- C. Curing Unformed Surfaces: Comply with **ACI 308.1** as follows:
- 1. Begin curing immediately after finishing concrete.
 - 2. Interior Concrete Floors:
 - a. Floors to Receive Floor Coverings Specified in Other Sections: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12 inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches**, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - b. Floors to Receive Penetrating Liquid Floor Treatments: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - a) Lap edges and ends of absorptive cover not less than **12 inches**.
 - b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
 - 2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches**, and sealed by waterproof tape or adhesive.
 - a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
 - b) Cure for not less than seven days.
 - 3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
 - c. Floors to Receive Polished Finish: Contractor has option of the following:
 - 1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive

- cover over entire area of floor.
- a) Lap edges and ends of absorptive cover not less than **12 inches**.
- b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.
- 2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:
 - a) Water.
 - b) Continuous water-fog spray.
- d. Floors to Receive Chemical Stain:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install curing paper over entire area of floor.
 - 2) Install curing paper square to building lines, without wrinkles, and in a single length without end joints.
 - 3) Butt sides of curing paper tight; do not overlap sides of curing paper.
 - 4) Leave curing paper in place for duration of curing period, but not less than 28 days.
- e. Floors to Receive Urethane Flooring:
 - 1) As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.
 - 2) Rewet absorptive cover, and cover immediately with polyethylene moisture-retaining cover with edges lapped **6 inches** and sealed in place.
 - 3) Secure polyethylene moisture-retaining cover in place to prohibit air from circulating under polyethylene moisture-retaining cover.
 - 4) Leave absorptive cover and polyethylene moisture-retaining cover in place for duration of curing period, but not less than 28 days.
- f. Floors to Receive Curing Compound:
 - 1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Maintain continuity of coating, and repair damage during curing period.
 - 4) Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer[**unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project**].
- g. Floors to Receive Curing and Sealing Compound:
 - 1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
 - 2) Recoat areas subjected to heavy rainfall within three hours after initial application.
 - 3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.11 TOLERANCES

- A. Conform to **ACI 117**.

3.12 JOINT FILLING

- A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least **[one]** **[six]** month(s).
 2. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least **2 inches** deep in formed joints.
- D. Overfill joint, and trim joint filler flush with top of joint after hardening.
- 3.13 CONCRETE SURFACE REPAIRS
- A. Defective Concrete:
1. Repair and patch defective areas when approved by Architect.
 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a **No. 16** sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than **1/2 inch** in any dimension to solid concrete.
 - a. Limit cut depth to **3/4 inch**.
 - b. Make edges of cuts perpendicular to concrete surface.
 - c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
 - d. Fill and compact with patching mortar before bonding agent has dried.
 - e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement, so that, when dry, patching mortar matches surrounding color.
 - a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
 - b. Compact mortar in place and strike off slightly higher than surrounding surface.
 3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces:
1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of **0.01 inch** wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 3. After concrete has cured at least 14 days, correct high areas by grinding.
 4. Correct localized low areas during, or immediately after, completing surface-finishing

- operations by cutting out low areas and replacing with patching mortar.
- a. Finish repaired areas to blend into adjacent concrete.
5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of **1/4 inch** to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 7. Repair defective areas, except random cracks and single holes **1 inch** or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a **3/4-inch** clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 8. Repair random cracks and single holes **1 inch** or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.14 FIELD QUALITY CONTROL
- A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.
 - B. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
 2. Testing agency to immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 3. Testing agency to report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.

- a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- D. Inspections:
 - 1. Headed bolts and studs.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
 - 6. Batch Plant Inspections: On a random basis, as determined by Architect.
- E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding **5 cu. yd.**, but less than **25 cu. yd.**, plus one set for each additional **50 cu. yd.** or fraction thereof.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - 2. Slump: ASTM C143/C143M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
 - 3. Slump Flow: ASTM C1611/C1611M:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.

- b. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; [ASTM C173/C173M volumetric method, for structural lightweight concrete].
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C1064/C1064M:
 - a. One test hourly when air temperature is **40 deg F** and below or **80 deg F** and above, and one test for each composite sample.
 6. Unit Weight: ASTM C567/C567M fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C31/C31M:
 - a. Cast and laboratory cure two sets of [two] [three] [four] **6-inch** by **12-inch** or **4-inch** by **8-inch** cylinder specimens for each composite sample.
 - b. Cast, initial cure, and field cure [two] <Insert number> sets of [two] [three] [four] standard cylinder specimens for each composite sample.
 8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one set of [two] [three] [four] laboratory-cured specimens at seven days and one set of two specimens at 28 days.
 - b. Test one set of [two] [three] [four] field-cured specimens at seven days and one set of two specimens at 28 days.
 - c. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than **500 psi** if specified compressive strength is **5000 psi**, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than **5000 psi**.
 11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 12. Additional Tests:
 - a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength to be in accordance with **ACI 301**, Section 1.6.6.3.
 13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- F. Measure floor and slab flatness and levelness in accordance with **ASTM E1155** within [24]

[48] [72] <Insert number> hours of completion of floor finishing and promptly report test results to Architect.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items on concrete surfaces.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 033000

SECTION 033543 - POLISHED CONCRETE FINISHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Polished concrete finishing[, **including staining**] [**and scoring**].
2. Concrete for polished concrete, including concrete materials, mixture design, placement procedures, initial finishing, and curing is specified in Section 033000 "Cast-in-Place Concrete."

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for concrete not designated as polished concrete.

1.2 DEFINITIONS

- A. Design Reference Sample:** Sample designated by Architect in the Contract Documents that reflects acceptable surface quality and appearance of polished concrete.

1.3 PREINSTALLATION MEETINGS

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

1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with polished concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Cast-in-place concrete subcontractor.
 - e. Polished concrete finishing Subcontractor.
2. Review [**cold- and hot-weather concreting procedures,**] [**curing procedures,**] [**construction joints,**] [**concrete repair procedures,**] [**concrete finishing,**] and protection of polished concrete.

1.4 ACTION SUBMITTALS

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

B. Sustainable Design Submittals:

1. Laboratory Test Reports: For [**stains**] [**and**] [**liquid floor treatments**], indicating compliance with requirements for low-emitting materials.

- C. Polishing Schedule:** Submit plan showing polished concrete surfaces and schedule of polishing operations for each area of polished concrete before start of polishing operations. Include locations of all joints, including construction joints.

- D. Samples for Initial Selection:** For each type of product requiring color selection.

- E. Samples for Verification:** For each type of exposed color.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:** For Installer.

B. Material Certificates: For each of the following, signed by manufacturers:

1. Repair materials.
2. Stain materials.
3. Liquid floor treatments.

1.6 QUALITY ASSURANCE

A. Field Sample Panels: After approval of verification sample and before casting concrete, produce field sample panels to demonstrate the approved range of selections made under Sample submittals. Produce a minimum of three sets of full-scale panels, approximately **48 by 48 inches** minimum, to demonstrate the expected range of finish, color, and appearance variations.

1. Locate panels as indicated or, if not indicated, as directed by Architect.
2. Maintain field sample panels during construction in an undisturbed condition as a standard for judging the completed Work.
3. Demolish and remove field sample panels when directed.

B. Mockups: Before casting concrete, build mockups to verify selections made under Sample submittals and to demonstrate typical joints, surface finish, tolerances, and standard of workmanship. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Demonstrate curing, finishing, and protecting of polished concrete.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 POLISHING

A. Polish: [**Level 1: Matte finish, 100 grit**] [**Level 2: Low sheen, 400 grit**] [**Level 3: High sheen, 800 grit**] [**Level 4: Gloss shine, 3000 grit**] [**Match design reference sample**].

B. Apply polished concrete finish system to cured and prepared slabs to match accepted mockup.

1. Machine grind floor surfaces to receive polished finishes level and smooth[**and to depth required to reveal aggregate to match approved mockup**].
2. Apply reactive stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
3. Apply penetrating liquid floor treatment for polished concrete in polishing sequence and according to manufacturer's written instructions, allowing recommended drying time between successive coats.
4. Apply penetrating stain for polished concrete in polishing sequence and according to manufacturer's written instructions.
5. Continue polishing with progressively finer-grit diamond polishing pads to gloss level, to match approved mockup.
6. Control and dispose of waste products produced by grinding and polishing operations.

7. Neutralize and clean polished floor surfaces.
- 3.2 STAINING
- A. Newly placed concrete to be at least [14] [30] <Insert number> days old before staining.
 - B. Prepare surfaces according to manufacturer's written instructions and as follows:
 1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
 - a. Do not use acidic solutions to clean surfaces.
 2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by [acid etching] [grinding, sanding, or abrasive blasting]. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
 3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
 4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F710 to ensure pH is between [7 and 8] <Insert values>.
 - C. Scoring: Score decorative jointing in concrete surfaces **1/16 inch** deep with diamond blades to match pattern indicated. Rinse until water is clear. Score [after] [before] staining.
 1. Joint Width: [**3/8 inch**] <Insert dimension>.
 - D. Allow concrete surface to dry before applying stain. Verify readiness of concrete to receive stain according to ASTM D4263 by tightly taping **18-by-18-inch, 4-mil-** thick polyethylene sheet to a representative area of concrete surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
 - E. Reactive Stain: Apply reactive stain to concrete surfaces according to manufacturer's written instructions and as follows:
 1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.
 - F. Penetrating Stain: Apply penetrating stain to concrete surfaces according to manufacturer's written instructions and as follows:
 1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
 2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

END OF SECTION 033543

SECTION 035300 - CONCRETE TOPPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each concrete floor topping, for tests performed by **[manufacturer and witnessed by a qualified testing agency]** **[a qualified testing agency]**.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency qualified according to ASTM C1077 and ASTM E329 for testing indicated.
- B. Mockups: Place concrete floor topping mockups to demonstrate typical joints, surface finish, bonding, texture, tolerances, and standard of workmanship.
 - 1. Build mockups approximately **100 sq. ft.** in the location indicated or, if not indicated, as directed by Architect.
 - 2. If Architect determines that mockups do not meet requirements, demolish and remove them from the site and cast others until mockups are approved.
 - 3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage, mixing with other components, and application.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture or other detrimental effects.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature and moisture content, ambient temperature and humidity, ventilation, and other conditions affecting concrete floor topping performance.
 - 1. Place concrete floor topping only when ambient temperature and temperature of base slabs are between **50 and 86 deg F.**
- B. Close areas to traffic during topping application and, after application, for time period recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately **9 oz./sq. yd.** when dry.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, 25 percent solids content, minimum.

2.2 RELATED MATERIALS

- A. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids [**epoxy resin with a Type A Shore durometer hardness of 80**] [**aromatic polyurea with a Type A Shore durometer hardness range of 90 to 95**] according to ASTM D2240.
- B. Joint-Filler Strips: [**ASTM D1751, asphalt-saturated cellulosic fiber**] [or] [**ASTM D1752, cork or self-expanding cork**].
- C. Portland Cement: ASTM C150/C150M, Type I or II.
- D. Sand: ASTM C404, fine aggregate passing **No. 16** sieve.
- E. Water: Potable.
- F. Acrylic-Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- G. Epoxy Adhesive: ASTM C881/C881M, Type V, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements.
- H. Power-Actuated Fasteners: Fastener systems with an evaluation report based on ICC-ES AC70.

2.3 MIXING

- A. Bonding Slurry:
 - 1. Mix portland cement with water to a thick paint consistency.
 - 2. Mix 1 part portland cement and [**1-1/2**] [**2**] [**2-1/2**] parts sand with water[**and an acrylic-bonding agent according to manufacturer's written instructions**] to a thick paint consistency.
- B. Floor Topping: Mix concrete floor topping materials and water in appropriate drum-type batch machine mixer or truck mixer according to manufacturer's written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

- B. Verify that base concrete slabs comply with scratch finish requirements specified in Section 033000 "Cast-in-Place Concrete."
- C. Verify that base slabs are visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D4263.
- D. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Existing Concrete: Remove existing surface treatments and deteriorated and unsound concrete. Mechanically abrade base slabs to produce a heavily scarified surface profile with an amplitude of **1/4 inch**.
 - 1. Prepare and clean existing base slabs according to concrete floor topping manufacturer's written instructions. Fill voids, cracks, and cavities in base slabs.
 - 2. Mechanically remove contaminants from existing concrete that might impair bond of floor topping.
 - 3. Saw cut contraction and construction joints in existing concrete to a depth of **1/2 inch** and fill with semirigid joint filler.
 - 4. To both sides of joint edges and at perimeter of existing base slab, [mechanically remove a **4-inch- wide and 0- to 1-inch- deep, tapered wedge of concrete and retexture surface**] [**install concrete nails in manufacturer's recommended staggered pattern**].
- B. Install joint-filler strips where topping abuts vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with topping surface unless otherwise indicated.
 - 2. Terminate full-width, joint-filler strips **1/2 inch** below topping surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- C. Install power-actuated fasteners according to written directions of floor topping manufacturer at perimeter of areas that are to receive floor topping, including both edges of locations where joints will be formed in floor topping.

3.3 FLOOR TOPPING APPLICATION

- A. Start floor topping application in presence of manufacturer's technical representative.
- B. Monolithic Floor Topping: After textured-float finish is applied to fresh concrete of base slabs specified in Section 033000 "Cast-in-Place Concrete," place concrete floor topping while concrete is still plastic.
- C. Deferred Floor Topping: Within 72 hours of placing base slabs, mix and scrub bonding slurry into dampened concrete to a thickness of **1/16 to 1/8 inch**, without puddling. Place floor topping while slurry is still tacky.
- D. Existing Concrete: Apply epoxy-bonding adhesive, mixed according to manufacturer's written instructions, and scrub into dry base slabs to a thickness of **1/16 to 1/8 inch**, without puddling. Place floor topping while adhesive is still tacky.

- E. Place concrete floor topping continuously in a single layer, tamping and consolidating to achieve tight contact with bonding surface. Do not permit cold joints or seams to develop within pour strip.
 - 1. Screed surface with a straightedge and strike off to correct elevations.
 - 2. Slope surfaces uniformly where indicated.
 - 3. Begin initial floating, using bull floats to form a uniform and open-textured surface plane free of humps or hollows.
 - F. Finishing: Consolidate surface with power-driven floats as soon as concrete floor topping can support equipment and operator. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until concrete floor topping surface has a uniform, smooth, granular texture.
 - 1. Hard Trowel Finish: After floating surface, apply first trowel finish and consolidate concrete floor topping by power-driven trowel without allowing blisters to develop. Continue troweling passes and restraighten until surface is smooth and uniform in texture.
 - a. Finish surfaces to specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15, and **[measure] [notify independent testing agency to permit measurement]** within 24 hours according to **ASTM E1155** for a randomly trafficked floor surface.
 - b. Finish and measure surface, so gap at any point between surface and an unleveled freestanding **10-foot-** long straightedge, resting on two high spots and placed anywhere on the surface, does not exceed **1/4 inch**.
 - G. Construction Joints: Construct joints true to line with faces perpendicular to surface plane of concrete floor topping, at locations indicated or as approved by Architect.
 - 1. Coat face of construction joint with epoxy adhesive at locations where concrete floor topping is placed against hardened or partially hardened concrete floor topping.
 - H. Contraction Joints: Form weakened-plane contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch-** wide joints into concrete floor topping when cutting action will not tear, abrade, or otherwise damage surface and before random contraction cracks develop.
 - 1. Form joints in concrete floor topping over contraction joints in base slabs unless otherwise indicated.
 - 2. Construct contraction joints for a combined depth equal to topping thickness and not less than one-fourth of base-slab thickness.
 - 3. Construct contraction joints for a depth equal to one-half of concrete floor topping thickness, but not less than **1/2 inch** deep.
- 3.4 PROTECTING AND CURING
- A. General: Protect freshly placed concrete floor topping from premature drying and excessive cold or hot temperatures.
 - B. Evaporation Retarder: Apply evaporation retarder to concrete floor topping surfaces in hot, dry, or windy conditions before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying floor topping, but before float finishing.
 - C. Begin curing immediately after finishing concrete floor topping. Cure by one or a combination

of the following methods, according to concrete floor topping manufacturer's written instructions:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with [water] [continuous water-fog spray] [or] [absorptive cover, water saturated and kept continuously wet. Cover topping surfaces and edges with **12-inch lap over adjacent absorptive covers**].
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least **12 inches**, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in two coats in continuous operations by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.5 JOINT FILLING

- A. Prepare and clean contraction joints and install semirigid joint filler, according to manufacturer's written instructions, once topping has fully cured.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.
- C. Install semirigid joint filler full depth of contraction joints. Overfill joint and trim semirigid joint filler flush with top of joint after hardening.

3.6 REPAIR

- A. Defective Topping: Repair and patch defective concrete floor topping areas, including areas that have not bonded to concrete substrate.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: [Owner will engage] [Engage] a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Testing Services: Testing and inspecting of completed applications of concrete floor toppings to take place in successive stages, in areas of extent and using methods as follows:
 1. Sample Sets: At point of placement, a set of three molded-cube samples to be taken from the topping mix for the first **1000 sq. ft.**, plus one set of samples for each subsequent **5000 sq. ft.** of topping, or fraction thereof, but not less than six samples for each day's placement. Samples to be tested according to ASTM C109/C109M for compliance with compressive-strength requirements.
 2. Concrete floor topping to be tested for delamination by dragging a steel chain over the surface.
 3. Concrete floor topping to be tested for compliance with surface flatness and levelness tolerances.
- C. Remove and replace applications of concrete floor topping where test results indicate that it does not comply with specified requirements.
- D. Additional testing and inspecting, at Contractor's expense, will be performed to determine

compliance of replaced or additional work with specified requirements.

END OF SECTION 035300

SECTION 051200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural-steel materials.
 - 2. Shrinkage-resistant grout.
 - 3. Shear stud connectors.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
 - 1. Shapes included in ASTM A6/A6M with flanges thicker than **1-1/2 inches**.
 - 2. Welded built-up members with plates thicker than **2 inches**.
 - 3. Column base plates thicker than **2 inches**.
- D. Protected Zone: Structural members or portions of structural members indicated as "protected zone" on Drawings. Connections of structural and nonstructural elements to protected zones are limited.
- E. Demand-Critical Welds: Those welds, the failure of which would result in significant degradation of the strength and stiffness of the seismic-load-resisting system and which are indicated as "demand critical" or "seismic critical" on Drawings.

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Structural-steel materials.
 - 2. High-strength, bolt-nut-washer assemblies.
 - 3. Shear stud connectors.
 - 4. Anchor rods.
 - 5. Threaded rods.

6. Forged-steel hardware.
 7. Slide bearings.
 8. Prefabricated building columns.
 9. Shop primer.
 10. Galvanized-steel primer.
 11. Etching cleaner.
 12. Galvanized repair paint.
 13. Shrinkage-resistant grout.
- B. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 2. Environmental Product Declaration: For each product.
 3. Health Product Declaration: For each product.
 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 5. Environmental Product Declaration: For each product.
 6. Environmental Product Declaration: For each product.
 7. Environmental Product Declaration: For each product.
 8. Third-Party Certifications: For each product.
 9. Third-Party Certified Life Cycle Assessment: For each product.
 10. Health Product Declaration (HPD): For each product.
 11. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
- C. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
 5. Identify members and connections of the seismic-load-resisting system.
 6. Indicate locations and dimensions of protected zones.
 7. Identify demand-critical welds.
 8. Identify members not to be shop primed.
- D. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint [**whether prequalified or qualified by testing**] [**qualified by testing**], including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand-critical welds.
- E. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data[**signed and sealed by the qualified professional engineer responsible for their preparation**].
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For [**Installer**] [**fabricator**] [**shop-painting applicators**] [**professional engineer**] [**testing agency**].

- B. Welding certificates.
 - C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
 - D. Mill test reports for structural-steel materials, including chemical and physical properties.
 - E. Product Test Reports: For the following:
 - 1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
 - 2. Direct-tension indicators.
 - 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 - 4. Shear stud connectors.
 - 5. **<Insert product>**.
 - F. Survey of existing conditions.
 - G. Source quality-control reports.
 - H. Field quality-control reports.
- 1.7 **QUALITY ASSURANCE**
- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).
 - B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, [**Category ACSE**] [**Category CSE**].
 - C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint [**Endorsement P1**] [**Endorsement P2**] [**Endorsement P3**] or to SSPC-QP 3.
 - D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.
 - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds are to pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G are to be considered separate processes for welding personnel qualification.
- 1.8 **DELIVERY, STORAGE, AND HANDLING**
- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
 - B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.

3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
 1. ANSI/AISC 303.
 2. ANSI/AISC 341.
 3. ANSI/AISC 360.
 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- B. Connection Design Information:
 1. Option 1: Connection designs have been completed and connections indicated on the Drawings.
 2. Option 2: Fabricator's experienced steel detailer selects or completes connections in accordance with ANSI/AISC 303.
 - a. Select and complete connections using [**schematic details indicated**] [**and**] [**ANSI/AISC 360**] **<Insert source>**.
 - b. Use [**Load and Resistance Factor Design; data are given at factored-load level**] [**Allowable Stress Design; data are given at service-load level**].
 3. Option 3 and 3A: Design connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer. Member reinforcement at connections is indicated on Drawings.
 - a. Use [**Load and Resistance Factor Design; data are given at factored-load level**] [**Allowable Stress Design; data are given at service-load level**].
 4. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional engineer.
 - a. Use [**Load and Resistance Factor Design; data are given at factored-load level**] [**Allowable Stress Design; data are given at service-load level**].
- C. Moment Connections: [**Type PR, partially**] [**Type FR, fully**] restrained.
- D. Construction: [**Moment frame**] [**Braced frame**] [**Shear wall system**] [**Combined system of moment frame and braced frame**] [**Combined system of moment frame and shear walls**] [**Combined system of braced frame and shear walls**] [**Combined system of moment frame, braced frame, and shear walls**].

2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] **<Insert value>** percent.
- B. W-Shapes: [**ASTM A992/A992M**] [**ASTM A572/A572M, Grade 50**] [**ASTM A529/A529M, Grade 50**] [**ASTM A913/A913M, Grade 50**].
- C. Channels, Angles, M-Shapes: [**ASTM A36/A36M**] [**ASTM A572/A572M, Grade 50**] [**ASTM A529/A529M, Grade 50**] [**ASTM A913/A913M, Grade 50**].
- D. Channels, Angles, S-Shapes: [**ASTM A36/A36M**] [**ASTM A572/A572M, Grade 50**]

[ASTM A529/A529M, **Grade 50**] [ASTM A913/A913M, **Grade 50**].

- E. Plate and Bar: [ASTM A36/A36M] [ASTM A572/A572M, **Grade 50**] [ASTM A529/A529M, **Grade 50**].
- F. Corrosion-Resisting (Weathering) Structural-Steel Shapes, Plates, and Bars: ASTM A588/A588M, **50 ksi**.
- G. Cold-Formed Hollow Structural Sections: [ASTM A500/A500M, **Grade B**] [ASTM A500/A500M, **Grade C**] [ASTM A1085/ASTMA1085M] structural tubing.
- H. Corrosion-Resisting (Weathering), Cold-Formed Hollow Structural Sections: ASTM A847/A847M structural tubing.
- I. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
 - 1. Weight Class: [Standard] [Extra strong] [Double-extra strong].
 - 2. Finish: [Black] [Galvanized] [Black except where indicated to be galvanized].
- J. Steel Castings: ASTM A216/A216M, Grade WCB, with supplementary requirement S11.
- K. Steel Forgings: ASTM A668/A668M.
- L. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

- A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, **Type 325-1**, compressible-washer type with plain finish.
- B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A490**, Type 1, heavy-hex steel structural bolts[**or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends**]; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959/F959M, **Type 490-1**, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, **Grade A325**, Type 1, heavy-hex steel structural bolts; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.
 - 1. Finish: [Hot-dip zinc coating] [Mechanically deposited zinc coating] [Hot-dip or mechanically deposited zinc coating].
 - 2. Direct-Tension Indicators: ASTM F959/F959M, **Type 325-1**, compressible-washer type with [mechanically deposited zinc coating] [mechanically deposited zinc coating, baked epoxy-coated] finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, [heavy-hex] [round] head assemblies, consisting of steel structural bolts with splined ends; **ASTM A563, Grade DH**, heavy-hex carbon-steel nuts; and

ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: **[Plain]** **[Mechanically deposited zinc coating]**.

- E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

- A. Unheaded Anchor Rods: **[ASTM F1554, Grade 36]** **[ASTM F1554, Grade 55, weldable]** **[ASTM A354]** **[ASTM A449]** **[ASTM A572/A572M, Grade 50]** **[ASTM A36/A36M]**.
1. Configuration: **[Straight]** **[Hooked]**.
 2. Nuts: **ASTM A563** **[heavy-]**hex carbon steel.
 3. Plate Washers: ASTM A36/A36M carbon steel.
 4. Washers: **ASTM F436**, Type 1, hardened carbon steel.
 5. Finish: **[Plain]** **[Hot-dip zinc coating, ASTM A153/A153M, Class C]** **[Mechanically deposited zinc coating, ASTM B695, Class 50]**.
- B. Headed Anchor Rods: **[ASTM F1554, Grade 36]** **[ASTM F1554, Grade 55, weldable]** **[ASTM A354]** **[ASTM A449]**, straight.
1. Nuts: **ASTM A563** **[heavy-]**hex carbon steel.
 2. Plate Washers: ASTM A36/A36M carbon steel.
 3. Washers: **ASTM F436**, Type 1, hardened carbon steel.
 4. Finish: **[Plain]** **[Hot-dip zinc coating, ASTM A153/A153M, Class C]** **[Mechanically deposited zinc coating, ASTM B695, Class 50]**.
- C. Threaded Rods: **[ASTM A36/A36M]** **[ASTM A193/A193M, Grade B7]** **[ASTM A354, Grade BD]** **[ASTM A449]** **[ASTM A572/A572M, Grade 50]**.
1. Nuts: **ASTM A63** **[heavy-]**hex carbon steel.
 2. Washers: **[ASTM F436, Type 1, hardened]** **[ASTM A36/A36M]** carbon steel.
 3. Finish: **[Plain]** **[Hot-dip zinc coating, ASTM A153/A153M, Class C]** **[Mechanically deposited zinc coating, ASTM B695, Class 50]**.

2.5 FORGED-STEEL STRUCTURAL HARDWARE

- A. Clevises and Turnbuckles: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1035.
- B. Eye Bolts and Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1030.
- C. Sleeve Nuts: Made from cold-finished carbon-steel bars, ASTM A108, AISI C-1018.

2.6 PRIMER

- A. Steel Primer:
1. Comply with **[Section 099113 "Exterior Painting" and Section 099123 "Interior Painting,"]** **[Section 099600 "High-Performance Coatings,"]** **[Section 099113 "Exterior Painting," Section 099123 "Interior Painting," and Section 099600 "High-Performance Coatings,"]**
 2. SSPC-Paint 23, latex primer.
 3. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanized-Steel Primer: **[MPI#26]** **[MPI#80,]** **[MPI#134]**.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: [MPI#18, MPI#19, or SSPC-Paint 20]
[ASTM A780/A780M].

2.7 SHRINKAGE-RESISTANT GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.8 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
 1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, [**mechanically thermal cut**,]or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with [SSPC-SP 1.] [SSPC-SP 2.] [SSPC-SP 3.]
- F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.
- G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.
- H. Welded-Steel Door Frames: Build up welded-steel doorframes attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than **10 inches** o.c. unless otherwise indicated on Drawings.

- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces.[**Do not thermally cut bolt holes or enlarge holes by burning.**]
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
- 2.9 SHOP CONNECTIONS
 - A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: [**Snug tightened**] [**Pretensioned**] [**Slip critical**].
 - B. Weld Connections: Comply with AWS D1.1/D1.1M[**and AWS D1.8/D1.8M**] for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- 2.10 GALVANIZING
 - A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize [**lintels**] [**shelf angles**] [**and**] [**welded door frames**] attached to structural-steel frame and located in exterior walls.
- 2.11 SHOP PRIMING
 - A. Shop prime steel surfaces, except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of **2 inches**.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces [**unless indicated to be painted**].
 - 6. Corrosion-resisting (weathering) steel surfaces.
 - 7. Surfaces enclosed in interior construction.
 - B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7 (WAB)/NACE WAB-4.
 - 4. SSPC-SP 14 (WAB)/NACE WAB-8.
 - 5. SSPC-SP 11.
 - 6. SSPC-SP 6 (WAB)/NACE WAB-3.
 - 7. SSPC-SP 10 (WAB)/NACE WAB-2.
 - 8. SSPC-SP 5 (WAB)/NACE WAB-1.

9. SSPC-SP 8.

- C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner [**or in accordance with SSPC-SP 16**].
- D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of **1.5 mils**. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.12 SOURCE QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform shop tests and inspections.
 - 1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect[**and test**] shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 - 3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E165/E165M.
 - b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E164.
 - d. Radiographic Inspection: ASTM E94/E94M.
 - 4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear stud connectors if weld fracture occurs on shear stud connectors already tested.
 - 5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural

steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

1. Do not remove temporary shoring supporting composite deck construction and structural-steel framing until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.
- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 2. Weld plate washers to top of baseplate.
 3. **[Snug-tighten] [Pretension]** anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. **[Comply with manufacturer's written installation instructions for grouting.]**
- C. Maintain erection tolerances of structural steel within ANSI/AISC 303.
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.
 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection **[unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M].**
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.
 1. Joint Type: **[Snug tightened] [Pretensioned] [Slip critical]**.
- B. Weld Connections: Comply with AWS D1.1/D1.1M **[and AWS D1.8/D1.8M]** for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 2. Remove backing bars or runoff tabs[**where indicated**], back gouge, and grind steel smooth.
 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.
- C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.
- B. Touchup Painting:
1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 2. Cleaning and touchup painting are specified in [Section 099113 "Exterior Painting."] [Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]
- C. Touchup Priming: Cleaning and touchup priming are specified in Section 099600 "High-Performance Coatings."

3.6 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector to perform the following special inspections:
1. Verify structural-steel materials and inspect steel frame joint details.
 2. Verify weld materials and inspect welds.
 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests and inspections.
1. Bolted Connections: Inspect[**and test**] bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
 2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.
 - a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E165/E165M.
 - 2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E164.
 - 4) Radiographic Inspection: ASTM E94/E94M.
 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded

shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

- a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
- b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 053100 - STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1.2 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Acoustical roof deck.
3. Composite floor deck.
4. Electrified cellular floor deck.
5. Noncomposite form deck.
6. Noncomposite vented form deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
3. Environmental Product Declaration (EPD): For each product.
4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
5. Environmental Product Declaration: For each product.
6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
7. Environmental Product Declaration: For each product.
8. Environmental Product Declaration: For each product.
9. Third-Party Certifications: For each product.
10. Third-Party Certified Life Cycle Assessment: For each product.
11. Health Product Declaration (HPD): For each product.
12. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
 - a. Power-actuated mechanical fasteners.

- b. Acoustical roof deck.
 - 2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.
 - D. Field Quality-Control Submittals:
 - 1. Field quality-control reports.
 - E. Qualification Statements: For [**welding personnel**] [**and**] [**testing agency**].
- 1.4 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.3/D1.3M.
 - B. Electrical Raceway Units: Provide UL-labeled cellular floor-deck units complying with UL 209 and listed in UL's "Electrical Construction Equipment Directory" for use with standard header ducts and outlets for electrical distribution systems.
 - C. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and [**Class 1-60**] [**Class 1-75**] [**Class 1-90**] windstorm ratings. Identify materials with FM Approvals Certification markings.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.
 - B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
 - 1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.
- B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] <**Insert value**> percent.

2.2 ACCESSORIES

- A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, **No. 10** minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of **33,000 psi**, not less than **0.0359-inch** design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of **33,000 psi**, of same material and finish as deck, and of thickness and profile **[indicated]** **[recommended by SDI standards for overhang and slab depth]**.
- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
- I. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, **[0.0598 inch]** **[0.0747 inch]** thick, with factory-punched hole of **3/8-inch** minimum diameter.
- J. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.
- K. Flat Sump Plates: Single-piece steel sheet, **0.0747 inch** thick, of same material and finish as deck. For drains, cut holes in the field.
- L. Recessed Sump Pans: Single-piece steel sheet, **0.0747 inch** thick, of same material and finish as deck, with **3-inch-** wide flanges and **[level]** **[sloped]** recessed pans of **1-1/2-inch** minimum depth. For drains, cut holes in the field.
- M. Galvanizing Repair Paint: **[ASTM A780/A780M]** **[SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight]**.
- N. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
 - 1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install in accordance with deck manufacturer's written instructions.
- J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF FLOOR DECK

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: **[5/8 inch] [3/4 inch]**, nominal.
 - 2. Weld Spacing:
 - a. Weld edge ribs of panels at each support. Space additional welds an average of **16 inches** apart, but not more than **18 inches** apart.
 - b. Space and locate welds as indicated.
 - 3. Weld Washers: Install weld washers at each weld location.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or **36 inches**, and as follows:
 - 1. Mechanically fasten with self-drilling, **No. 10** diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of **1-1/2-inch-** long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of **[1-1/2 inches] <Insert dimension>**, with end joints as follows:
 - 1. End Joints: **[Lapped] [Butted] [Lapped or butted at Contractor's option]**.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting

structure in accordance with SDI recommendations unless otherwise indicated.

- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
- F. Electrified Cellular Floor Deck: Install cellular floor system with deck assembled from [**all-cellular units**] [**alternating cellular units with noncellular composite units**] [**units indicated**].
 - 1. Coordinate layout and installation of trench headers, preset inserts, duct fittings, and other components specified in Section 260539 "Underfloor Raceways for Electrical Systems" with installation of electrified cellular metal floor deck.
- G. Install piercing hanger tabs at [**14 inches**] [**Insert dimension**] apart in both directions, within **9 inches** of walls at ends, and not more than **12 inches** from walls at sides unless otherwise indicated.

3.4 REPAIR

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.
- B. Repair Painting:
 - 1. Wire brush and clean rust spots, welds, and abraded areas on [**both surfaces**] [**top surface**] of prime-painted deck immediately after installation, and apply repair paint.
 - 2. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
 - 3. Wire brushing, cleaning, and repair painting of bottom deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
 - 4. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 - 1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.
 - a. Field welds will be subject to inspection.
 - 2. Steel decking will be considered defective if it does not pass tests and inspections.
 - 3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional

shear connectors if weld fracture occurs on shear connectors that are already tested.

- C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

- A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Expanded metal infill panels.
3. Perforated metal infill panels.
4. Woven-wire mesh infill panels.
5. Fasteners.
6. Post-installed anchors.
7. Handrail brackets.
8. Shop primer.
9. Intermediate coats and topcoats.
10. Bituminous paint.
11. Nonshrink, nonmetallic grout.
12. Anchoring cement.
13. Metal finishes.
14. Paint products.

- B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- D. Samples for Initial Selection: For products involving selection of color, texture, or design[, **including mechanical finishes**].

- E. Samples for Verification: For each type of exposed finish required.

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters, including finish.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of [**connecting**] [**and**] [**finishing**] members at intersections.

- F. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[delegated design professional engineer]** **[testing agency]**.
- B. Welding certificates.
- C. Mill Certificates: Signed by manufacturers of stainless steel products, certifying that products furnished comply with requirements.
- D. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- E. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.
- F. Research Reports: For post-installed anchors, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect mechanical finishes on exposed surfaces of railings from damage by applying a strippable, temporary protective covering before shipping.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with railings by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of **50 lbf/ ft.** applied in any direction.
 - b. Concentrated load of **200 lbf** applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of **50 lbf** applied horizontally on an area of **1 sq. ft.**
 - b. Infill load and other loads need not be assumed to act concurrently.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [**120 deg F, ambient; 180 deg F, material surfaces**] <Insert temperature change>.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with [**flange tapped for concealed anchorage to threaded hanger bolt**] [**predrilled hole for exposed bolt anchorage**] and that provides **1-1/2-inch** clearance from inside face of handrail to finished wall surface.

2.3 FASTENERS

- A. Fastener Materials:

1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/F1941M, Class Fe/Zn 5 for zinc coating.
2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
3. Aluminum Railing Components: [**Type 304**] [**Type 316**] stainless steel fasteners.
4. Stainless Steel Railing Components: [**Type 304**] [**Type 316**] stainless steel fasteners.
5. Finish exposed fasteners to match appearance, including color and texture, of railings.

- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction[**and capable of withstanding design loads**].

- C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.
3. Provide [**Phillips**] [**tamper-resistant**] [**square or hex socket**] flat-head machine screws for exposed fasteners unless otherwise indicated.

- D. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193[**or ICC-ES AC308**].

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy [Group **1**] [Group **2**] stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.4 MISCELLANEOUS MATERIALS

- A. Handrail Brackets: [**Cast iron**] [**Cast aluminum,**] [**Cast stainless steel,**] [**Cast nickel-silver,**] center of handrail [**2-1/2 inches**] [**3-1/8 inches**] <Insert dimension> from [**face of railing**]

[wall].

- B. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
 - 1. For **[aluminum]** **[and]** **[stainless steel]** railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.
- C. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- D. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- E. Shop Primers: Provide primers that comply with **[Section 099113 "Exterior Painting."]** **[Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]**
- F. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- G. Epoxy Zinc-Rich Primer: Complying with MPI#20 and compatible with topcoat.
- H. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- I. Intermediate Coats and Topcoats: Provide products that comply with **[Section 099113 "Exterior Painting."]** **[Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]**
- J. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- K. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- L. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.
- M. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- N. 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.
 - 1. Water-Resistant Product: **[At exterior locations]** **[and]** **[where indicated on Drawings]**, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage[, **but not less than that required to**

support structural loads].

- B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations.
 - 1. Clearly mark units for reassembly and coordinated installation.
 - 2. Use connections that maintain structural value of joined pieces.
- C. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately **1/32 inch** unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that are exposed to weather in a manner that excludes water.
 - 1. Provide weep holes where water may accumulate.
 - 2. Locate weep holes in inconspicuous locations.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with **[welded]** **[or]** **[nonwelded]** connections unless otherwise indicated.
- H. Gates: Form gates from steel tube of same size and shape as top rails, with infill to match guards. Provide with **[cam-type, self-closing]** **[spring]** hinges for fastening to wall and overlapping stop with rubber bumper to prevent gate from opening in direction opposite egress.
- I. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for **[Finish #1 welds; ornamental quality with no evidence of a welded joint]** **[Finish #2 welds; good appearance, completely sanded joint, some undercutting and pinholes okay]** **[Finish #3 welds; utilitarian appearance not subject to view, partially dressed weld with spatter removed]**.
- J. Welded Connections for Aluminum Pipe: Fabricate railings to interconnect members with concealed internal welds that eliminate surface grinding, using manufacturer's standard system of sleeve and socket fittings.
- K. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
 - 1. Fabricate splice joints for field connection, using an epoxy structural adhesive, if this is manufacturer's standard splicing method.
- L. Form changes in direction as follows:
 - 1. As detailed.

2. **[By bending] [or] [by inserting prefabricated elbow fittings].**
 3. **[By flush bends] [or] [by inserting prefabricated flush-elbow fittings].**
 4. **[By radius bends of radius indicated] [or] [by inserting prefabricated elbow fittings of radius indicated].**
 5. By bending to smallest radius that will not result in distortion of railing member.
- M. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- N. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- O. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is **1/4 inch** or less.
- P. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- Q. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 2. Coordinate anchorage devices with supporting structure.
- R. For railing posts set in concrete, provide stainless steel sleeves not less than **6 inches** long with inside dimensions not less than **1/2 inch** greater than outside dimensions of post, with metal plate forming bottom closure.
- S. For removable railing posts, fabricate slip-fit sockets from stainless steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height.
1. Provide socket covers designed and fabricated to resist being dislodged.
 2. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.
- T. Expanded-Metal Infill Panels: Fabricate infill panels from expanded-metal sheet of same metal as railings.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as expanded metal and not less than **0.043 inch** thick.
 2. Orient expanded metal with long dimension of diamonds **[parallel to top rail]** **[perpendicular to top rail]** **[horizontal]** **[vertical]**.
- U. Perforated-Metal Infill Panels: Fabricate infill panels from perforated metal made from **[steel]** **[galvanized steel]** **[aluminum]** **[stainless steel]** **[same metal as railings in which they are installed]**.
1. Edge panels with U-shaped channels made from metal sheet, of same metal as perforated metal and not less than **0.043 inch** thick.

2. Orient perforated metal with pattern [**parallel to top rail**] [**perpendicular to top rail**] [**horizontal**] [**vertical**] [**as indicated on Drawings**].
 - V. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into **1-by-1/2-by-1/8-inch** metal channel frames.
 1. Fabricate wire mesh and frames from same metal as railings in which they are installed.
 2. Orient wire mesh with [**diamonds vertical**] [**diamonds perpendicular to top rail**] [**wires perpendicular and parallel to top rail**] [**wires horizontal and vertical**] [**as indicated on Drawings**].
 - W. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.
- 2.6 STEEL AND IRON FINISHES
- A. Galvanized Railings:
 1. Hot-dip galvanize [**exterior**] [**indicated**] steel railings, including hardware, after fabrication.
 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
 4. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 5. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
 - C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner[**and as follows**].
 1. Comply with SSPC-SP 16.
 - D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
 - E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [**SSPC-SP 6/NACE No. 3.**] [**SSPC-SP 3.**] [**requirements indicated below:**]
 1. Exterior Railings: SSPC-SP 6/NACE No. 3.
 2. Railings Indicated To Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
 3. Railings Indicated To Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
 4. Other Railings: SSPC-SP 3.
 - F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
 1. Shop prime uncoated railings with [**universal shop primer**] [**primers specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting"**] unless [**zinc-rich primer is**] [**primers specified in Section 099600 "High-Performance**

Coatings" are] indicated.

2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with [Section 099113 "Exterior Painting."] [Section 099600 "High-Performance Coatings."]

1. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

H. High-Performance Coating: Apply epoxy intermediate and polyurethane topcoats to prime-coated surfaces. Comply with coating manufacturer's written instructions and with requirements in SSPC-PA 1 for shop painting. Apply at spreading rates recommended by coating manufacturer.

1. Color: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range].

2.7 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

C. Clear Anodic Finish: AAMA 611, [AA-M12C22A41] [AA-M12C22A31].

D. Color Anodic Finish: AAMA 611, [AA-M12C22A42/A44] [AA-M12C22A32/A34].

1. Color: [Light bronze] [Medium bronze] [Dark bronze] [Black] [Match Architect's sample] [As selected by Architect from full range of industry colors and color densities].

E. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

F. High-Performance Organic Finish, Two-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with [AAMA 2604] [AAMA 2605] and containing not less than [50] [70] percent polyvinylidene fluoride (PVDF) resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [for seacoast and severe environments].

1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

G. Superior Performance Organic Finish, Three-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare,

pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [**for seacoast and severe environments**].

1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <Insert color and gloss>.
 - H. Superior Performance Organic Finish, Four-Coat Polyvinylidene Fluoride (PVDF): Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions [**for seacoast and severe environments**].
 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <Insert color and gloss>.
 - I. Single-Coat Superior Performance FEVE Organic Finish: Single-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish, complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <Insert color and gloss>.
 - J. Two-Coat Superior Performance FEVE Organic Finish: Two-coat fluoroethylene vinyl ether (FEVE) fluoropolymer finish complying with AAMA 2605. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
 1. Color and Gloss: [**As indicated by manufacturer's designations**] [**Match Architect's sample**] [**As selected by Architect from manufacturer's full range**] <Insert color and gloss>.
- 2.8 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 grain with long dimension of each piece.
 2. When polishing is completed, passivate and rinse surfaces.
 3. Remove embedded foreign matter and leave surfaces chemically clean.
 - C. Stainless Steel Pipe and Tubing Finishes:
 1. 180-Grit Polished Finish: Uniform, directionally textured finish.
 2. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.
 3. Polished and Buffed Finish: 320-grit finish followed by buffing [**to a high luster finish**] [**to a mirror-like finish**] [**to match Architect's sample**].
 - D. Stainless Steel Sheet and Plate Finishes:
 1. Directional Satin Finish: ASTM A480/A480, No. 4.
 2. High-Luster Finish: ASTM A480/A480M, No. 7.
 3. Mirror Finish: ASTM A480/A480M, No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
 - 1. Fit exposed connections together to form tight, hairline joints.
 - 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 - 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 - 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 5. Set posts plumb within a tolerance of **1/16 inch in 3 feet**.
 - 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed **1/4 inch in 12 feet**.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.
 - 1. Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- C. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- D. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

- A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws, using plastic cement filler colored to match finish of railings.
- B. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article, whether welding is performed in the shop or in the field.
- C. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve, extending **2 inches** beyond joint on either side; fasten internal sleeve securely to one side; and locate joint within **6 inches** of post.

3.4 ANCHORING POSTS

- A. Use stainless 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 to comply with anchoring material manufacturer's written instructions.

- B. Form or core-drill holes not less than **5 inches** deep and **3/4 inch** larger than OD of post for installing posts in concrete. 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.
- C. Cover anchorage joint with flange of same metal as post, **[welded to post after placing anchoring material]** **[attached to post with setscrews]**.
- D. Leave anchorage joint exposed with **[1/8-inch buildup, sloped away from post]** **[anchoring material flush with adjacent surface]**.
- E. Anchor posts to metal surfaces with flanges, angle type, or floor type, as required by conditions, connected to posts and to metal supporting members as follows:
 - 1. For steel railings, weld flanges to post and bolt to metal supporting surfaces.
 - 2. For aluminum railings, attach posts as indicated, using fittings designed and engineered for this purpose.
 - 3. For stainless steel railings, weld flanges to post and bolt to supporting surfaces.
- F. Install removable railing sections, where indicated, in slip-fit stainless steel sockets cast in concrete.

3.5 ATTACHING RAILINGS

- A. Anchor railing ends to concrete and masonry with **[sleeves concealed within]** **[flanges connected to]** **[brackets on underside of rails connected to]** railing ends and anchored to wall construction with anchors and bolts.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and **[welded to railing ends]** **[or]** **[connected to railing ends, using nonwelded connections]**.
- C. Attach handrails to walls with wall brackets[, **except where end flanges are used**]. Provide brackets with **[1-1/2-inch]** **<Insert dimension>** clearance from inside face of handrail and finished wall surface.
 - 1. Use type of bracket with **[flange tapped for concealed anchorage to threaded hanger bolt]** **[predrilled hole for exposed bolt anchorage]**.
 - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets[**and railing end flanges**] to building construction as follows:
 - 1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
 - 2. For hollow masonry anchorage, use toggle bolts.
 - 3. For wood stud partitions, use hanger or lag bolts set into studs or wood backing between studs. Coordinate with carpentry work to locate backing members.
 - 4. For steel-framed partitions, use hanger or lag bolts set into **[fire-retardant-treated]** wood backing between studs. Coordinate with stud installation to locate backing members.
 - 5. For steel-framed partitions, fasten brackets directly to steel framing or concealed steel reinforcements, using self-tapping screws of size and type required to support structural loads.

6. For steel-framed partitions, use toggle bolts installed through flanges of steel framing or through concealed steel reinforcements.
 - E. Install railing gates level, plumb, and secure for full opening without interference.
 1. Attach hardware using tamper-resistant or concealed means.
 2. Adjust hardware for smooth operation.
- 3.6 REPAIR
- A. Touchup Painting:
 1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - a. Apply by brush or spray to provide a minimum **2.0-mil** dry film thickness.
 2. Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [Section 099113 "Exterior Painting."] [Section 099123 "Interior Painting."] [Section 099600 "High-Performance Coatings."]
- 3.7 CLEANING
- A. Clean [aluminum] [and] [stainless steel] by washing thoroughly with clean water and soap and rinsing with clean water.
 - B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.
- 3.8 PROTECTION
- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.
 - B. Restore finishes damaged during installation and construction period, so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 055213

SECTION 071353 - ELASTOMERIC SHEET WATERPROOFING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
1. Review waterproofing requirements including surface preparation, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Include construction details, material descriptions, and tested physical and performance properties of waterproofing.
 2. Include manufacturer's written instructions for evaluating, preparing, and treating substrate.
- B. Sustainable Design Submittals:
1. Product data: For waterproofing providing information for testing in compliance with ASHRAE 160-2009.
- C. Shop Drawings: Show locations and extent of waterproofing and details of substrate joints and cracks, expansion joints, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
1. Include setting drawings showing layout, sizes, sections, profiles, and joint details of pedestal-supported concrete pavers.
- D. Samples: For each exposed product and for each color and texture specified, including the following products:
1. **8-by-8-inch** square of waterproofing and flashing sheet.
 2. **4-by-4-inch** square of drainage panel.
 3. Plaza-deck paver, [**4-by-4-inch square**] [**full sized**], in each color and texture required.
 4. Paver pedestal assembly.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Field quality-control reports.
- C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to set quality

standards for installation.

1. Build for each typical waterproofing installation including[**pavers and**] accessories to demonstrate surface preparation, crack and joint treatments, inside and outside corner treatments, and protection.
 - a. Size: [**100 sq. ft. in area**] [**As indicated on Drawings**].
 - b. Description: Each type of [**wall**] [**deck**] [**and**] [**plaza**] **<Insert description>** installation.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended in writing by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.

1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement waterproofing material for waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.
 1. Warranty Period: [**10**] [**20**] **<Insert number>** years from date of Substantial Completion.
- B. Installer's Special Warranty: Specified form, [**on warranty form at end of this Section**], signed by Installer, covering Work of this Section, for warranty period of [**two**] **<Insert number>** years.
 1. Warranty includes removing and reinstalling protection board, drainage panels, insulation, pedestals, and pavers on plaza decks.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Waterproofing System: Obtain waterproofing materials[, **protection course**], [**and**] [**molded-sheet drainage panels**] from single source from single manufacturer.
- B. Source Limitations for Plaza-Deck Paving: Obtain plaza-deck pavers[**and paver pedestals**] from single source from single manufacturer.

2.2 ACCESSORIES

- A. Furnish accessory materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 1. Furnish liquid-type accessory materials that comply with VOC limits of authorities having jurisdiction.
- B. Concealed Sheet Flashing: Same material, construction, and thickness as sheet waterproofing or **60-mil-** thick, uncured EPDM, as required by manufacturer.

- C. Exposed Sheet Flashing: **60-mil-** thick EPDM, cured or uncured, as required by manufacturer.
- D. Bonding Adhesives: For bonding waterproofing sheets and sheet flashings to substrates and projections.
- E. Splicing Cement and Cleaner: Single-component butyl splicing cement and solvent-based splice cleaner.
 - 1. Butyl Gum Tape: **30-mil-** thick by **6-1/4-inch-** wide, uncured butyl with polyethylene release film.
- F. Lap Sealant: Single-component sealant.
- G. In-Seam Sealant: Single-component sealant.
- H. Water-Cutoff Mastic: Butyl mastic sealant.
- I. Waterproofing and Sheet-Flashing Accessories: Sealants, pourable sealers, cone and vent flashings, inside and outside corner flashings, termination reglets, and other accessories recommended by waterproofing manufacturer for intended use.
- J. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately **1 inch** wide, prepunched, with fasteners.
- K. Semirigid sheets of asphalt-impregnated organic mat, mineral surface, with a nominal thickness of **1/8 inch**.
- L. Fan folded, with a core of extruded-polystyrene board insulation, a nominal thickness of **1/4 inch**, and a compressive strength of not less than **8 psi**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of waterproofing.
 - 1. Verify that concrete has cured and aged for minimum time period recommended in writing by waterproofing manufacturer.
 - 2. Verify that substrate is visibly dry and within the moisture limits recommended in writing by manufacturer. Test for capillary moisture by plastic sheet method in accordance with ASTM D4263.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.

- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks in accordance with ASTM D4258.
- F. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions.

3.3 INSTALLATION OF FULLY ADHERED SHEET

- A. Install fully adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions and in accordance with recommendations in ASTM D5843.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply bonding adhesive to substrates at required rate and allow it to partially dry.
- D. Apply bonding adhesive to sheets and firmly adhere sheets to substrates. Do not apply bonding adhesive to splice area of sheet.
- E. Install fully adhered sheets and accessory materials to tie into existing waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.
- G. Horizontal Application: Apply sheets with side laps shingled with slope of deck where possible.
 - 1. Spread sealant bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.

3.4 INSTALLATION OF PARTIALLY ADHERED SHEET

- A. Install partially adhered sheets over entire area to receive waterproofing according to manufacturer's written instructions.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply bonding adhesive to the following areas of substrates and to each sheet at required rate and allow it to partially dry:
 - 1. Upper 25 percent of length of each sheet and **18 inches** around perimeter of each sheet.
- D. Firmly adhere sheets to substrate. Do not apply bonding adhesive to splice area of sheet.
- E. Install partially adhered sheets and accessory materials to tie into existing waterproofing.
- F. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.5 INSTALLATION OF COMPARTMENTED, LOOSELY LAID SHEET

- A. Install compartmented, loosely laid sheets over entire area to receive waterproofing according to manufacturer's written instructions.
- B. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required. Stagger end laps.
- C. Apply continuous beads of water-cutoff mastic, of size recommended in writing by waterproofing manufacturer, to substrates in a **60-by-60-inch** grid pattern before installing sheet.
- D. Apply sheets with side laps shingled with slope of deck where possible.
- E. Spread sealant bed over deck drain flange at deck drains and securely seal sheet waterproofing in place with clamping ring.
- F. Install compartmented, loosely laid sheets and accessory materials to tie into existing waterproofing.
- G. Repair tears, voids, and lapped seams in waterproofing that do not comply with requirements. Slit and flatten fishmouths and blisters. Patch with sheet waterproofing extending beyond repaired areas in all directions.

3.6 INSTALLATION OF SEAMS

- A. Cement Splice: Clean splice areas, apply splicing cement and in-seam sealant, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to produce a splice not less than **6 inches** wide and to ensure a watertight seam installation. Apply lap sealant and seal edges of sheet terminations.
- B. Cement and Tape Splice: Clean splice areas, apply splicing cement and butyl gum tape, and firmly roll side and end laps of overlapping sheets according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal edges of sheet terminations.

3.7 INSTALLATION OF SHEET FLASHING

- A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to waterproofing manufacturer's written instructions.
- B. Form wall flashings using exposed sheet flashing.
- C. Extend deck sheet waterproofing to form wall flashings.
 - 1. Flash penetrations and field-formed inside and outside corners with uncured sheet flashing.
 - 2. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight installation. Apply lap sealant and seal edges of sheet-flashing terminations.
- D. Cover expansion joints and discontinuous deck-to-wall or deck-to-deck joints by extending deck sheet waterproofing over joints.

- E. Terminate and seal top of sheet flashings[**with mechanically anchored termination bars**].

3.8 INSTALLATION OF PROTECTION COURSE

- A. Install protection course over waterproofing membrane according to manufacturer's written instructions and before beginning subsequent construction operations. Minimize exposure of membrane.
 - 1. **[Molded-sheet drainage panels]** **[Insulation drainage panels]** **[Board insulation]** may be used in place of a separate protection course for vertical applications when approved by waterproofing manufacturer.

3.9 INSTALLATION OF MOLDED-SHEET DRAINAGE PANEL

- A. Place and secure molded-sheet drainage panels, with geotextile facing away from wall or deck substrate, according to manufacturer's written instructions. Use adhesive or another method that does not penetrate waterproofing. Lap edges and ends of geotextile to maintain continuity. Protect installed molded-sheet drainage panels during subsequent construction.
 - 1. For vertical applications, install **[board insulation]** **[protection course]** before installing drainage panels.

3.10 INSTALLATION OF INSULATION DRAINAGE PANEL

- A. Install insulation drainage panels over waterproofed surfaces. Cut and fit to within **3/4 inch** of projections and penetrations.
- B. Ensure that drainage channels are aligned and free of obstructions.
- C. On vertical surfaces, set insulation drainage panels in adhesive or tape applied according to manufacturer's written instructions.
- D. On horizontal surfaces, loosely lay insulation drainage panels according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

3.11 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests.
- B. Manufacturer's Field Service: Engage a **[full-time]** site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions, surface preparation, membrane application, flashings, protection, and drainage components; and to furnish daily reports to Architect.
- C. Flood Testing: Flood test each deck area for leaks, in accordance with procedures in ASTM D5957, after completing waterproofing but before placing overlying construction. Install temporary containment assemblies, plug or dam drains, and flood with potable water.
 - 1. Flood to an average depth of **2-1/2 inches** with a minimum depth of **1 inch** and a maximum depth of **4 inches**. Maintain **2 inches** of clearance from top of sheet flashings.
 - 2. Flood each area for **[24]** **[48]** **[72]** hours.
 - 3. Testing agency is to observe flood testing and examine underside of decks and terminations for evidence of leaks during flood testing.
 - 4. After flood testing, repair leaks, repeat flood tests, and make further repairs until waterproofing installation is watertight.
- D. Waterproofing will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.
- 3.12 PROTECTION, REPAIR, AND CLEANING
- A. Do not permit foot or vehicular traffic on unprotected membrane.
 - B. Protect waterproofing from damage and wear during remainder of construction period.
 - C. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
 - D. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
 - E. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071353

SECTION 071900 - WATER REPELLENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data:

1. Penetrating water repellents.
2. Film-forming water repellents.
3. MPI-approved water repellents.

- B. Product Data Submittals:

1. Include manufacturer's printed statement of VOC content.
2. Include manufacturer's standard colors.
3. Include manufacturer's recommended number of coats for each type of substrate and spreading rate for each separate coat.
4. Include printout of current "MPI Approved Products List" for each product category specified in Part 2 that specifies water repellents approved by MPI, with the proposed product highlighted.

- C. Samples: For each type[**and color**] of water repellent and substrate indicated, **12 by 12 inches** in size, with specified water-repellent treatment applied to half of each Sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Applicator]** **[testing agency]**.
- B. Product Certificates: For each type of water repellent.
- C. Preconstruction Test Reports: For water-repellent-treated substrates.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: An employer of workers trained and approved by manufacturer.
- B. MPI Standards: Comply with MPI standards indicated and provide water repellents listed in its "MPI Approved Products List."
- C. Mockups: Prepare mockups of each required water repellent on each type of substrate required to demonstrate aesthetic effects,[**for preconstruction testing,**] and to set quality standards for materials and execution.
1. Locate mockups [**where shown on Drawings**] [**on masonry sample panels**] [**on existing surfaces where directed by Architect**] [**in locations that enable viewing**]

under same conditions as the completed Work] <Insert requirement>.

- a. Size: **[10 sq. ft.] [25 sq. ft.] <Insert size> each.**
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Engage a qualified testing agency to perform preconstruction testing of water repellents on **[field mockups] [manufacturer's standard substrate assemblies] [on existing substrate assemblies]**.
 1. In addition to verifying performance requirements, use mockups to verify manufacturer's written instructions for application procedure and optimum rates of product application to substrates.
 2. Propose changes to materials and methods to suit Project.
 3. Notify Architect **[seven] <Insert number> days** in advance of the dates and times when mockups will be tested.

1.7 FIELD CONDITIONS

- A. Limitations: Proceed with application only when the following existing and forecasted weather and substrate conditions permit water repellents to be applied in accordance with manufacturers' written instructions and warranty requirements:
 1. Concrete surfaces and mortar have cured for not less than 28 days.
 2. Building has been closed in for not less than 30 days before treating wall assemblies.
 3. Ambient temperature is above **40 deg F** and below **100 deg F** and will remain so for 24 hours.
 4. Substrate is not frozen and substrate-surface temperature is above **40 deg F** and below **100 deg F**.
 5. Rain or snow is not predicted within 24 hours.
 6. Not less than **[24 hours] [seven days]** have passed since surfaces were last wet.
 7. Windy conditions do not exist that might cause water repellent to be blown onto vegetation or surfaces not intended to be treated.
 8. **<Insert restriction>.**

1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which **[manufacturer] [and] [Applicator]** agree(s) to repair or replace materials that fail to maintain water repellency specified in "Performance Requirements" Article within specified warranty period.
 1. Warranty Period: **[Two] [Five] <Insert number> years** from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Performance: Water repellents must meet the following performance requirements as determined by **[preconstruction]** testing on **[manufacturer's standard]** substrates representing those indicated for this Project.
- B. Water Absorption: Minimum **[80] [90] <Insert number> percent** reduction of water absorption after 24 hours for treated compared to untreated specimens when tested according to the

following:

1. Cast-in-Place Concrete: ASTM C642.
 2. Precast Concrete: ASTM C642.
 3. Cast Stone: ASTM C1195.
 4. Concrete Masonry Units: ASTM C140.
 5. Clay Brick: ASTM C67.
 6. Natural Stone: ASTM C97/C97M.
 7. Portland Cement Plaster (Stucco): ASTM D6532.
- C. Water-Vapor Transmission: Comply with one or both of the following:
1. Maximum [10] <Insert number> percent reduction in water-vapor transmission of treated compared to untreated specimens, in accordance with ASTM E96/E96M.
 2. Minimum [80] <Insert number> percent water-vapor transmission of treated compared to untreated specimens, in accordance with ASTM D1653.
- D. Water Penetration and Leakage through Masonry: Minimum [90] <Insert number> percent reduction in leakage rate of treated compared to untreated specimens, in accordance with ASTM E514/E514M.
- E. Durability: Maximum [5] <Insert number> percent loss of water-repellent performance after 2500 hours of weathering in accordance with ASTM G154 compared to water-repellent-treated specimens before weathering.
- F. Chloride-Ion Intrusion in Concrete: NCHRP Report 244, Series II tests.
1. Reduction of Water Absorption: [80] <Insert number> percent.
 2. Reduction in Chloride Content: [80] <Insert number> percent.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements and conditions affecting performance of the Work.
1. Verify that surfaces are clean and dry in accordance with water-repellent manufacturer's requirements. Check moisture content in [three] <Insert number> representative locations by method recommended by manufacturer.
 2. Verify that there is no efflorescence or other removable residues that would be trapped beneath the application of water repellent.
 3. Verify that required repairs are complete, cured, and dry before applying water repellent.
- B. Test pH level in accordance with water-repellent manufacturer's written instructions to ensure chemical bond to silica-containing or siliceous minerals.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. New Construction and Repairs: Allow concrete and other cementitious materials to age before application of water repellent, in accordance with repellent manufacturer's written instructions.
- B. Cleaning: Before application of water repellent, clean substrate of substances that could impair penetration or performance of product in accordance with water-repellent manufacturer's written instructions[**and as follows:**][.]

1. [Cast-in-Place Concrete] [Precast Concrete] [Cast Stone] [and] [Concrete Unit Masonry]: Remove oil, curing compounds, laitance, and other substances that inhibit penetration or performance of water repellents [in accordance with ASTM E1857] <Insert requirement>.
 2. Clay Brick Masonry: [ASTM D5703.] [Section 040110 "Masonry Cleaning."]
 3. Natural Stone: [ASTM C1515.] [ASTM D5107.] [Section 040110 "Masonry Cleaning."]
 4. Portland Cement Plaster (Stucco): [ASTM E1857] <Insert requirement>.
- C. Protect adjoining work, including mortar and sealant bond surfaces, from spillage or blow-over of water repellent. Cover adjoining and nearby surfaces of aluminum and glass if there is the possibility of water repellent being deposited on surfaces. Cover live vegetation.
- D. Coordination with Mortar Joints: Do not apply water repellent until pointing mortar for joints adjacent to surfaces receiving water-repellent treatment has been installed and cured.
- E. Coordination with Sealant Joints: Do not apply water repellent until sealants for joints adjacent to surfaces receiving water-repellent treatment have been installed and cured.
1. Water-repellent work may precede sealant application only if sealant adhesion and compatibility have been tested and verified using substrate, water repellent, and sealant materials identical to those required.
- 3.3 APPLICATION OF WATER REPELLENTS
- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect the substrate before application of water repellent and to instruct Applicator on the product and application method to be used.
- B. Apply coating of water repellent on surfaces to be treated using [**15 psi- pressure spray with a fan-type spray nozzle**] [roller] [or] [brush] <Insert requirement> to the point of saturation. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation. Comply with manufacturer's written instructions for application procedure unless otherwise indicated.
1. [**Precast Concrete**] [and] [**Cast Stone**]: At Contractor's option, first application of water repellent may be completed before installing units. Mask mortar and sealant bond surfaces to prevent water repellent from migrating onto joint surfaces. Remove masking after repellent has cured.
- C. Apply a second saturation coating, repeating first application. Comply with manufacturer's written instructions for limitations on drying time between coats and after rainstorm wetting of surfaces between coats. Consult manufacturer's technical representative if written instructions are not applicable to Project conditions.
- 3.4 FIELD QUALITY CONTROL
- A. Testing of Water-Repellent Material: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when water repellent is being applied:
1. Owner will engage the services of a qualified testing agency to sample water-repellent material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 2. Testing agency will perform tests for compliance of water-repellent material with product

requirements.

3. Owner may direct Contractor to stop applying water repellents if test results show material being used does not comply with product requirements. Contractor to remove noncomplying material from Project site, pay for testing, and correct deficiency of surfaces treated with rejected materials, as approved by Architect. **<Insert additional requirements to suit Project>.**

- B. Coverage Test: In the presence of Architect, hose down a dry, repellent-treated surface to verify complete and uniform product application. A change in surface color will indicate incomplete application.

1. Notify Architect [**seven**] **<Insert number>** days in advance of the dates and times when surfaces will be tested.
2. Reapply water repellent until coverage test indicates complete coverage.

3.5 CLEANING

- A. Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application, as approved by Architect.
- B. Comply with manufacturer's written cleaning instructions.

END OF SECTION 071900

SECTION 072419 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Water-drainage exterior insulation and finish system (EIFS).
 - 1. EIFS-clad drainage-wall assemblies that are field applied over substrate.
 - 2. Water-resistive barrier coatings.
- B. Related Requirements:
 - 1. Section 072413 "Polymer-Based Exterior Insulation and Finish System (EIFS)" for EIFS-clad barrier-wall assemblies.
 - 2. Section 072500 "Weather Barriers" for water-resistant building paper or building wrap and flexible flashings installed over sheathing behind mechanically fastened EIFS.
 - 3. Section 072600 "Vapor Retarders" for wall sheet vapor retarders.
 - 4. Section 072713 "Modified Bituminous Sheet Air Barriers" for self-adhering sheet air barriers composed of bituminous materials applied over sheathing behind mechanically fastened EIFS.
 - 5. Section 072715 "Nonbituminous Self-Adhering Sheet Air Barriers" for self-adhering sheet air barriers composed of nonbituminous polymers applied over sheathing behind mechanically fastened EIFS.
 - 6. Section 072726 "Fluid-Applied Membrane Air Barriers" for fluid-applied, synthetic polymer air barriers applied over sheathing behind EIFS-clad wall assemblies.

1.2 DEFINITIONS

- A. Definitions in ASTM E2110 apply to Work of this Section.
- B. EIFS: Exterior insulation and finish system(s).
- C. IBC: International Building Code.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each EIFS component, trim, and accessory[, **including water-resistive barrier coatings**].
- B. Sustainable Design Submittals:
 - 1. Manufacturer Inventory: For each product, provide manufacturer's manifest of ingredients.
 - 2. Manufacturer Inventory: Provide manufacturer's ingredient inventory.
 - 3. Product Data: For insulation, indicating that R-values comply with tables in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air Conditioning."
 - 4. Laboratory Test Reports: For Insulation, indicating compliance with requirements for low-emitting materials.
 - 5. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.
 - 6. Laboratory Test Reports: For insulation, indicating compliance with requirements for

- low-emitting materials.
 - 7. Laboratory Test Reports: For insulation, indicating compliance with requirements for low-emitting materials.
 - 8. Health Product Declaration (HPD): Provide documentation confirming product compliance with one of the following:
 - a. Inventory or HPD to at least 0.01 percent by weight, with at least 95 percent assessed using GreenScreen Benchmark assessment.
 - b. Cradle to Cradle v3 certification with minimum Silver level of Material Health.
 - c. Living Product Challenge certification indicating achievement of Imperative 09, "Transparent Material Health."
 - C. Health Product Declaration (HPD): Provide documentation indicating that manufacturer has screened and publicly provided ingredient disclosure to 1000 ppm, and has developed an action plan to mitigate known hazards.
 - D. Shop Drawings:
 - 1. Include details for EIFS buildouts.
 - 2. Include details for parapet cap flashing.
 - E. Samples: For each exposed product and for each color and texture specified, [**8 inches square**] **<Insert dimension and shape>** in size.
 - F. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
 - 1. Include similar Samples of exposed accessories involving color selection.
 - G. Samples for Verification: **24-inch-** square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work, including [**custom trim, each profile,**] [**and**] [**an aesthetic reveal**].
 - 1. Include [**exposed trim and accessory**] **<Insert item>** Samples to verify color selected.
 - 2. Include a typical control joint filled with sealant of color selected, as specified in Section 079200 "Joint Sealants."
- 1.5 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Manufacturer Certificates: Signed by EIFS manufacturer, certifying the following:
 - 1. EIFS complies with requirements.
 - 2. Substrates to which EIFS is indicated to be attached are acceptable to EIFS manufacturer.
 - 3. Accessory products installed with EIFS, including [**joint sealants,**] [**flashing,**] [**water-resistive barrier coatings,**] [**trim,**] **<Insert accessory>** whether or not furnished by EIFS manufacturer and whether or not specified in this Section, are acceptable to EIFS manufacturer.
 - C. Product Certificates: For[**cementitious materials and aggregates and for**] insulation and joint sealant, from manufacturer.
 - D. Product Test Reports: For each EIFS assembly and component, [**and for water-resistive barrier coatings,**] for tests performed by a qualified testing agency.
 - E. Field quality-control reports.

- F. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For EIFS to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: [**An installer who is certified in writing by AWCI International as qualified to install Class PB EIFS using trained workers**] <Insert requirements>.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, to set quality standards for materials and execution, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original, unopened packages with manufacturers' labels intact and clearly identifying products.
- B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.
 - 1. Stack insulation board flat and off the ground.
 - 2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.9 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.
 - 1. Proceed with installation of adhesives or coatings only when ambient temperatures have remained, or are forecast to remain, above **40 deg F** for a minimum of 24 hours before, during, and after application. Do not apply EIFS adhesives or coatings during rainfall.

1.10 WARRANTY

- A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Bond integrity and weathertightness.
 - b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.

2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:
 - a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
 - b. Insulation installed as part of EIFS[**including foam buildouts**].
 - c. Insulation adhesive[**and mechanical fasteners**].
 - d. EIFS accessories, including trim components and flashing.
 - e. Water-resistive barrier coatings.
 - f. EIFS drainage components.
3. Warranty Period: [**Five**] [**10**] **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. EIFS Performance: Comply with ASTM E2568 and with the following:
 1. Weathertightness: Resistant to uncontrolled water penetration from exterior, with a means to drain water entering EIFS to the exterior.
 2. System Fire Performance: [**Fire-resistance rating of wall assembly**] [**Full-scale multistory fire test**].
 3. Structural Performance of Assembly and Components:
 - a. Wind Loads:
 - 1) Uniform pressure of **<Insert lbf/sq. ft.>**, acting inward or outward.
 - 2) Uniform pressure as indicated on Drawings.
 4. Impact Performance: ASTM E2568, [**Standard**] [**Medium**] [**High**] [**Ultra High**] impact resistance[**unless otherwise indicated**].
 5. Abrasion Resistance of Finish Coat: Sample consisting of **1-inch-** thick EIFS mounted on **1/2-inch-** thick gypsum board; cured for a minimum of 28 days and shows no cracking, checking, or loss of film integrity after exposure to **528 quarts** of sand when tested in accordance with ASTM D968, Method A.
 6. Mildew Resistance of Finish Coat: Sample applied to **2-by-2-inch** clean glass substrate; cured for 28 days and shows no growth when tested in accordance with ASTM D3273 and evaluated in accordance with ASTM D3274.
 7. Drainage Efficiency: 90 percent average minimum when tested in accordance with ASTM E2273.

2.2 EIFS MATERIALS

- A. Water-Resistive Barrier Coating: EIFS manufacturer's standard formulation and accessories for use as water-resistive barrier coating; compatible with substrate.
 1. Water-Resistance: Comply with physical and performance criteria of ASTM E2570/E2570M.
 2. VOC Content: [**250**] **<Insert value>** g/L or less.
 3. Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. VOC Content: [**100**] **<Insert value>** g/L or less.
 5. Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

6. VOC Content: [100] <Insert value> g/L or less.
 7. Low-Emitting Materials: VOC emissions of coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 8. VOC Content: [100] <Insert value> g/L or less.
 9. Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 10. VOC Emissions: Coatings shall contain no more than half of the chronic REL of VOCs when tested according to the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt, and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- C. Insulation Adhesive: EIFS manufacturer's standard formulation designed for indicated use; **[specifically formulated to be applied to back side of insulation in a manner that creates open vertical channels designed to serve as an integral part of the water-drainage system of the EIFS-clad drainage-wall assembly;]**compatible with substrate; and complying with **[one of]** the following:
1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, and polymer-based adhesive specified for base coat.
 2. Factory-blended dry formulation of portland cement, dry polymer admixture, and fillers specified for base coat.
 3. Factory-mixed noncementitious formulation designed for adhesive attachment of insulation to substrates of type indicated, as recommended by EIFS manufacturer.
 4. Adhesives shall have a VOC content of [50] <Insert value> g/L or less.
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 8. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

- Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
9. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- D. Drainage Mat: [**Three-dimensional, nonwoven, entangled filament, nylon or plastic**] [**Woven or fused, self-furring, PVC mesh lath**] <Insert type> mat designed to drain incidental moisture by gravity; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer, with manufacturer's standard corrosion-resistant mechanical fasteners suitable for intended substrate.
- E. Molded, (Expanded) Rigid Cellular Polystyrene Board Insulation: Comply with ASTM E2430/E2430M, unless otherwise noted, and the following:
1. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, in accordance with ASTM E84.
 2. Dimensions: Provide insulation boards of not more than **24 by 48 inches**, with thickness indicated on Drawings.
 3. Channeled Board Insulation: EIFS manufacturer's standard factory-fabricated profile with linear, vertical-drainage channels, slots, or waves on the back side of board.
 4. Foam Buildouts: Provide with profiles and dimensions indicated on Drawings.
- F. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than **120 lbf/in.** in accordance with ASTM E2098/E2098M and the following:
1. Reinforcing Mesh for EIFS, General: Not less than weight required to comply with impact-performance level specified in "Performance Requirements" Article.
 2. Strip-Reinforcing Mesh: Not less than [**3.75 oz./sq. yd.**] [**As recommended by EIFS manufacturer**] <Insert weight>.
 3. Detail-Reinforcing Mesh: Not less than [**4.0 oz./sq. yd.**] [**As recommended by EIFS manufacturer**] <Insert weight>.
 4. Corner-Reinforcing Mesh: Not less than [**7.2 oz./sq. yd.**] [**As recommended by EIFS manufacturer**] <Insert weight>.
- G. Base Coat: EIFS manufacturer's standard mixture complying with[**one of**] the following:
1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.
 2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.
 3. Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
 4. Factory-mixed noncementitious formulation of polymer-emulsion adhesive and inert fillers that is ready to use without adding other materials.
 5. Adhesives shall have a VOC content of [**50**] <Insert value> g/L or less.
 6. Adhesive shall comply with the testing and product requirements of the California

- Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 8. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 9. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 10. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- H. Water-Resistant Base Coat: EIFS manufacturer's standard water-resistant formulation complying with **[one of]** the following:
1. Job-mixed formulation of portland cement complying with ASTM C150/C150M, Type I, white or natural color; and manufacturer's standard polymer-emulsion adhesive designed for use with portland cement.
 2. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.
 3. Adhesives shall have a VOC content of **[50]** **<Insert value>** g/L or less.
 4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 8. Adhesive shall comply with the testing and product requirements of the California

Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

- I. Mechanical Fasteners: EIFS manufacturer's standard corrosion-resistant fasteners, consisting of thermal cap, standard washer and shaft attachments, and fastener indicated below; designed to resist Project's design loads; capable of pulling fastener head below surface of insulation board; and complying with the following:
 1. For attachment to steel studs from **0.033 to 0.112 inch** in thickness, provide steel drill screws complying with ASTM C954.
 2. For attachment to light-gage steel framing members not less than **0.0179 inch** in thickness, provide steel drill screws complying with ASTM C1002.
 3. For attachment to wood framing members and plywood sheathing, provide steel drill screws complying with ASTM C1002, Type W.
 4. For attachment to masonry and concrete substrates, provide sheathing dowel in form of a plastic wing-tipped fastener with thermal cap, sized to fit insulation thickness indicated and to penetrate substrate to depth required to secure anchorage.
 5. For attachment to **<Insert substrate>**, provide manufacturer's standard fasteners suitable for substrate.
- J. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.
 1. VOC Content: **[250]** **<Insert value>** g/L or less.
 2. Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 3. VOC Content: **[100]** **<Insert value>** g/L or less.
 4. Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 5. VOC Content: **[100]** **<Insert value>** g/L or less.
 6. Low-Emitting Materials: VOC emissions of coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 7. VOC Content: **[100]** **<Insert value>** g/L or less.
 8. Low-Emitting Materials: Coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 9. VOC Emissions: Coatings shall contain no more than half of the chronic REL of VOCs when tested according to the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde

shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

- K. Finish Coat: EIFS manufacturer's **[standard acrylic-based coating] [standard acrylic-based coating with enhanced mildew resistance] [siliconized acrylic-based coating] [elastomeric coating] <Insert coating>** complying with the following:
1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
 2. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, and fillers used with stone particles for embedding in finish coat to produce an applied-aggregate finish.
 - a. Aggregate: Marble chips of size and color **[as indicated by manufacturer's designations] [to match Architect's sample] [as selected by Architect from manufacturer's full range]**.
 3. Colors: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]**.
 4. Textures: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range]**.
- L. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.
- M. Water: Potable.
- N. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D1784, manufacturer's standard cell class for use intended, and ASTM C1063.
1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
 2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
 3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg **[extended to form a drip]** and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.
 4. Expansion Joint: Closed-cell polyethylene backer rod and elastomeric sealant **3/4-inch-**minimum.
 5. Windowsill Flashing: Prefabricated type for both flashing and sloping sill over framing beneath windows; with end and back dams; designed to direct water to exterior.
 6. Parapet Cap Flashing: Type for both flashing and covering parapet top, with design complying with ASTM C1397 **[and ANSI/SPRI/FM 4435/ES-1]**.

2.3 MIXING

- A. Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials, except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Begin coating application only after surfaces are dry.
 - 2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.
- B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.
- C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.
 - 1. Concrete Substrates: Provide clean, dry, neutral-pH substrate for insulation installation. Verify suitability of substrate by performing bond and moisture tests recommended by EIFS manufacturer.

3.3 INSTALLATION OF EIFS, GENERAL

- A. Comply with ASTM C1397, ASTM E2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

3.4 APPLICATION OF SUBSTRATE PROTECTION

- A. Water-Resistive Barrier Coating: Apply over [**sheathing**] <Insert substrate> to provide a water-resistive barrier.
 - 1. Tape and seal joints, exposed edges, terminations, and inside and outside corners of sheathing unless otherwise indicated by EIFS manufacturer's written instructions.
- B. Flexible-Membrane Flashing: Install over water-resistive barrier coating, applied and lapped to shed water; seal at openings, penetrations, and terminations. Prime substrates with flashing primer if required and install flashing.

3.5 INSTALLATION OF TRIM

- A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, [**at windowsills,**] and elsewhere as indicated. Coordinate with installation of insulation.
 - 1. Weep Screed/Track: Use at bottom termination edges, at window and door heads[, **and at floor line expansion joints**] of water-drainage EIFS unless otherwise indicated.
 - 2. Windowsill Flashing: Use at windows unless otherwise indicated.
 - 3. Expansion Joint: Use where indicated on Drawings.

4. Casing Bead: Use at other locations.
5. Parapet Cap Flashing: Use where indicated on Drawings.
6. **<Insert trim and requirements>.**

3.6 INSTALLATION OF DRAINAGE MAT

- A. Drainage Mat: Apply wrinkle free, continuously, with edges **[butted]** **[overlapped]** and mechanically secured with fasteners over water-resistive barrier coating.

3.7 INSTALLATION OF INSULATION

- A. Board Insulation: **[Adhesively]** **[Mechanically]** **[Adhesively and mechanically]** attach insulation to substrate in compliance with ASTM C1397 and the following:
 1. Apply adhesive to insulation by notched-trowel method, with notches oriented vertically to produce drainage channels that remain functional after the insulation is adhered to substrate.
 2. Apply adhesive to insulation by notched-trowel method in a manner that results in coating the entire surface of drainage mat with adhesive once insulation is adhered to drainage mat.
 3. Apply adhesive to ridges on back of channeled insulation by notched-trowel method in a manner that results in full adhesive contact over the entire surface of ridges, leaving channels free of adhesive once insulation is adhered to substrate.
 4. Press and slide insulation into place. Apply pressure over entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
 5. Allow adhered insulation to remain undisturbed for not less than 24 hours, before **[installing mechanical fasteners,]** beginning rasping and sanding insulation or applying base coat and reinforcing mesh.
 6. Mechanically attach insulation to substrate. Install top surface of fastener heads flush with plane of insulation. Install fasteners into or through substrates with the following minimum penetration:
 - a. Steel Framing: **5/16 inch.**
 - b. Wood Framing: **1 inch.**
 - c. Concrete and Masonry: **1 inch.**
 7. Apply insulation over substrates in courses with long edges of boards oriented horizontally.
 8. Begin first course of insulation from a level base line and work upward.
 9. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
 10. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints, so no piece of insulation is less than **12 inches** wide or **6 inches** high. Offset joints not less than **6 inches** from corners of window and door openings[and not less than **4 inches from aesthetic reveals**].
 - a. Adhesive Attachment: Offset joints of insulation not less than **6 inches** from horizontal and **4 inches** from vertical joints in sheathing.
 - b. Mechanical Attachment: Offset joints of insulation from horizontal joints in sheathing.
 11. Apply channeled insulation, with drainage channels aligned vertically.
 12. Interlock ends at internal and external corners.
 13. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than **1/16 inch** occur, fill with insulation cut to fit gaps exactly; insert insulation without

- using adhesive or other material.
14. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
 15. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than **[1/32 inch] [1/16 inch]** from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than **1/16 inch**. Prevent airborne dispersal and immediately collect insulation raspings or sandings.
 16. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than **3/4 inch**.
 17. Install foam buildouts and attach to structural substrate by **[adhesive] [mechanical fastening] [adhesive and mechanical fastening]**.
 18. Interrupt insulation for expansion joints where indicated.
 19. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.
 20. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.
 21. Before installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than **2-1/2 inches** over front and back face unless otherwise indicated on Drawings.
 22. Treat exposed edges of insulation as follows:
 - a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
 - b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
 - c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.
 23. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier coating.
- B. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:
1. At expansion joints in substrates behind EIFS.
 2. Where EIFS adjoin dissimilar substrates, materials, and construction, including other EIFS.
 3. At floor lines in multilevel wood-framed construction.
 4. Where wall height or building shape changes.
 5. Where EIFS manufacturer requires joints in long continuous elevations.
- 3.8 APPLICATION OF BASE COAT
- A. Water-Resistant Base Coat: Apply full-thickness coverage **[to exposed insulation and]** to exposed surfaces of **[sloped shapes] [window sills] [parapets] [foam build-outs] <Insert location>** and to other surfaces indicated on Drawings.
- B. Base Coat: Apply full coverage to exposed insulation **[and foam build-outs]** with not less than

[1/16-inch] <Insert dimension> dry-coat thickness.

- C. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than **2-1/2 inches** or otherwise treated at joints to comply with ASTM C1397. Do not lap reinforcing mesh within **8 inches** of corners. Completely embed mesh, applying additional base-coat material if necessary, so reinforcing-mesh color and pattern are invisible.
- D. Double-Layer Reinforcing-Mesh Application: Where indicated or required, apply second base coat and second layer of reinforcing mesh, overlapped not less than **2-1/2 inches** or otherwise treated at joints to comply with ASTM C1397 in same manner as first application. Do not apply until first base coat has cured.
- E. Additional Reinforcing Mesh: Apply strip-reinforcing mesh around openings, extending **4 inches** beyond perimeter. Apply additional **9-by-12-inch** strip-reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply **8-inch-** wide, strip-reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than **4 inches** on each side of corners.
 - 1. At aesthetic reveals, apply strip-reinforcing mesh not less than **8 inches** wide.
 - 2. Embed strip-reinforcing mesh in base coat before applying first layer of reinforcing mesh.
- F. Foam Buildouts: Fully embed reinforcing mesh in base coat.
- G. Double Base-Coat Application: Where indicated, apply second base coat in same manner and thickness as first application, except without reinforcing mesh. Do not apply until first base coat has cured.

3.9 APPLICATION OF FINISH COAT

- A. Primer: Apply over dry base coat.
- B. Finish Coat: Apply full-thickness coverage over dry [**primed**] base coat, maintaining a wet edge at all times for uniform appearance, to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.
 - 1. Embed aggregate in finish coat to produce a uniform applied-aggregate finish of color and texture matching approved sample.
- C. Sealer Coat: Apply over dry finish coat, in number of coats and thickness required by EIFS manufacturer.

3.10 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Water-resistive barrier coatings applied over sheathing.
 - 2. <Insert special inspections>.
- B. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- C. EIFS Tests and Inspections: In accordance with ASTM E2359/E2359M <Insert tests and

inspections>.

D. EIFS will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

END OF SECTION 072419

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Building paper.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Building paper.
2. Building wrap.
3. Drainage wrap.
4. Flexible flashing.
5. Drainage material.

B. Product Data Submittals: For [**building wrap**] [**drainage wrap**], include data on air and water-vapor permeance based on testing in accordance with referenced standards.

C. Shop Drawings: Show details of [**building paper**] [**building wrap**] [**drainage wrap**] at terminations, openings, and penetrations. Show details of flexible flashing applications.

D. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
4. Environmental Product Declaration: For each product.
5. Environmental Product Declaration: For each product.
6. Environmental Product Declaration: For each product.
7. Third-Party Certifications: For each product.
8. Third-Party Certified Life Cycle Assessment: For each product.
9. Health Product Declaration (HPD): For each product.
10. Health Product Declaration (HPD): Provide HPD.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For [**water-resistive barrier**] [**and**] [**flexible flashing**], from ICC-ES.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 072500

SECTION 072600 - VAPOR RETARDERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Polyethylene vapor retarders.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Polyethylene vapor retarders.
 - 2. Reinforced-polyethylene vapor retarders.
 - 3. Fire-retardant, reinforced-polyethylene vapor retarders.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D4397, [~~6-mil-~~] [~~10-mil-~~] thick sheet, with maximum permeance rating of **0.1 perm.**

2.2 ACCESSORIES

- A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
- B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.
- C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Place vapor retarders on side of construction indicated on Drawings.
- B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- D. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and

vapor retarders.

- E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES

- A. Install vapor retarders over prepared grade. Lap joints a minimum of **12 inches** and seal with manufacturer's recommended tape. Install second layer over pathways to equipment.
- B. Extend vapor retarder over footings and seal to foundation wall or grade beam with manufacturer's recommended tape.
 - 1. Extend vapor retarder vertically minimum [**16 inches**] [**24 inches**] <Insert dimension> above top of footing.
- C. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

3.4 PROTECTION

- A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION 072600

SECTION 074213.23 - METAL COMPOSITE MATERIAL WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal composite material (MCM) panels.
 - 2. Metal composite material (MCM) system.
- B. Related Requirements:
 - 1. Section 014339 "Mockups" for integrated exterior mockup requirements.
 - 2. Section 019119.43 "Exterior Enclosure Commissioning."

1.2 DEFINITIONS

- A. DBVC: Drained and back-ventilated cavity rainscreen system designed to drain and dry water entering cavity through drainage channels, weeps, and air ventilation.
- B. MCM: Metal composite material; cladding material formed by joining two thin metal skins to polyethylene or fire-retardant core and bonded under precise temperature, pressure, and tension.
- C. PER: Pressure-equalized rainscreen system designed for no water intrusion, with equal pressure within air cavity and outside cladding barrier.

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, MCM system Installer, MCM system manufacturer's representative, and installers whose work interfaces with or affects MCM panels, including installers of doors, windows, and louvers.
 - 2. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 3. Review methods and procedures related to MCM system installation, including manufacturer's written instructions.
 - 4. Examine support conditions for compliance with requirements, including alignment between and attachment to structural members.
 - 5. Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect MCM system.
 - 6. Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - 7. Review temporary protection requirements for system assembly during and after installation.
 - 8. Review procedures for repair of panels damaged after installation.
 - 9. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.4 ACTION SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel, system, and accessory.
 - 1. Metal composite material (MCM) panels.
 - 2. Metal composite material (MCM) system.

- B. Shop Drawings:
1. Include fabrication and installation layouts of MCM system; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, accessories, and special details.
 2. Accessories: Include details of flashing, trim, and anchorage, at a scale of not less than **1-1/2 inches per 12 inches**.
 3. Provide signed and sealed drawings, by a qualified design professional in Project jurisdiction, of MCM system showing compliance with performance requirements and design criteria identified for this Project.
- C. Samples for Initial Selection: For each type of MCM panel indicated, with factory-applied color finishes.
1. Size: [**Manufacturers' standard size**] <Insert size>.
 2. Include Samples of trim and accessories involving color selection.
- D. Samples for Verification: For each type of [**MCM panel**] [**and**] [**MCM system**] required, with factory-applied color finishes.
1. MCM Panel: [**One sample**] [**Two samples**], [**2 by 3 inches**] [**4 by 6 inches**] [**Manufacturers' standard size**] <Insert size>.
 2. MCM System: **12 inches** long by actual panel width, fabricated into panel systems indicated. Include fasteners, closures, and other MCM panel accessories. [**Panel sample need not be provided in the specified color.**]
- E. Delegated Design Submittals: For MCM system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- F. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 2. Environmental Product Declaration: For each product.
 3. Health Product Declaration: For each product.
 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 5. Environmental Product Declaration: For each product.
 6. Environmental Product Declaration: For each product.
 7. Environmental Product Declaration: For each product.
 8. Third-Party Certifications: For each product.
 9. Third-Party Certified Life Cycle Assessment: For each product.

1.5 INFORMATIONAL SUBMITTALS

- A. Test and Evaluation Reports:
1. Product Test Reports: For each [**MCM panel**] [**MCM system**], for tests performed by [**qualified testing agency**] [**manufacturer and witnessed by a qualified testing agency**].
 - a. MCM Panel Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance in accordance with the IBC.
 - b. Fabricator's MCM System Test Reports: Certified test reports showing system compliance with specific performance or third-party listing documenting compliance in accordance with the IBC.

- 1) Dry or Wet Seal System: Tested to AAMA 501.1.
 - 2) DBVC System: Tested to AAMA 509.
 - 3) PER System: Tested to AAMA 508.
 2. Research Reports: For MCM systems, from **[an agency acceptable to authorities having jurisdiction] [ICC-ES] <Insert evaluation agency>** showing compliance with **<Insert requirement>**.
 3. Preconstruction Test Reports: For MCM system.
 - B. Field Quality-Control Submittals:
 1. Field quality-control reports.
 - C. Qualification Statements: For **[manufacturer] [fabricator] [Installer] [testing agency]**.
 - D. Delegated design engineer qualifications.
 - E. Sample warranties.
- 1.6 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For MCM panels.
 - B. Warranty Documentation:
 1. Manufacturers' special warranties.
 2. Installer's special warranties.
- 1.7 QUALITY ASSURANCE
- A. Manufacturer Qualifications: **[Minimum 5 years' experience] <Insert requirements>**.
 - B. Fabricator Qualifications: **[Approved by MCM panel manufacturer] [Certified MCM fabricator by the Metal Construction Association]**.
 - C. Installer Qualifications: **[Fabricator of MCM system] [Entity that employs installers and supervisors who are trained and approved by MCM system manufacturer]**.
 - D. Delegated Design Engineer Qualifications: A professional engineer who is legally qualified to practice in **[state] <Insert jurisdiction>** where Project is located and who is experienced in providing engineering services of the type indicated.
 - E. Testing Agency Qualifications: An agency acceptable to authorities having jurisdiction.
- 1.8 MOCKUPS
- A. Build mockups **[to verify selections made under Sample submittals] [to demonstrate aesthetic effects] [to set quality standards for fabrication and installation] [and] [for preconstruction testing]**.
 1. Build mockup **[as indicated on Drawings] <Insert size>**, including **[corner,] [soffits,] supports, attachments, and accessories.** **[Panel sample need not be provided in the specified color.]**
 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.
 3. Subject to compliance with requirements, approved mockups may become part of the

completed Work if undisturbed at time of Substantial Completion.

1.9 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: **[Owner will engage] [Engage]** a qualified testing agency to perform preconstruction testing on **<Insert product> [field mockups] [laboratory mockups]**.
 - 1. **<Insert sizes and configurations of assemblies>**.
 - 2. Provide test specimens and assemblies representative of proposed materials and construction.
 - 3. Build laboratory mockups at testing agency facility; use personnel, materials, and methods of construction that will be used at Project site.
 - 4. Notify Architect **[seven] <Insert number>** days in advance of dates and times when laboratory mockups will be tested.
- B. Preconstruction Testing: Performed by a qualified testing agency on manufacturer's standard assemblies.
 - 1. Water-Spray Test: Conduct water-spray test[**of mockup**] of MCM system, testing for water penetration in accordance with AAMA 501.2.
 - 2. Seismic Performance: Conduct seismic test[**of mockup**] of MCM system, testing for seismic performance in accordance with AAMA 501.4.
 - 3. PER System: Conduct all tests to determine wall performance and pressure equalization in accordance with AAMA 508.
 - 4. DBVC System: Conduct all tests to determine wall performance and provide a V/W classification in accordance with AAMA 509.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.
- B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack MCM panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.
- D. Retain strippable protective covering on MCM panels during installation.
- E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.11 FIELD CONDITIONS

- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.12 COORDINATION

- A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.13 WARRANTY

- A. Panel Integrity Warranty: Manufacturer agrees to repair or replace components of MCM panels that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.
 - 2. Warranty Period: [**Two**] [**Five**] [**10**] <Insert number> years from date of Substantial Completion.
- B. Panel Finish Warranty: Manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: [**20**] [**10**] <Insert number> years from date of Substantial Completion.
- C. MCM System Warranty: [**System manufacturer's**] [**Fabricator's**] standard form in which manufacturer agrees to repair or replace components of MCM systems that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: [**One**] [**Two**] [**Five**] <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 MCM system.
- B. Seismic Performance: No failure or deterioration of the system when laterally racked to **3/4 inch** in both directions and repeated for three cycles in accordance with AAMA 501.4. System must pass the static water test as described in ASTM E331 following the seismic racking.
- C. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.
- D. Structural Performance: MCM systems to withstand the effects of the following loads, based on testing in accordance with ASTM E330/E330M:
 - 1. Wind Loads: As indicated on Drawings.
 - 2. Other Design Loads: [**As indicated on Drawings**] <Insert loads>.
 - 3. Deflection Limits: For wind loads, no greater than [**1/180**] [**1/240**] <Insert deflection> of the span.
 - 4. <Insert serviceability requirements>.
- E. Air Infiltration: Air leakage of not more than **0.06 cfm/sq. ft.** when tested in accordance with ASTM E283/E283M at the following test-pressure difference:
 - 1. Test-Pressure Difference: [**1.57 lbf/sq. ft.**] [**6.24 lbf/sq. ft.**].

- F. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:
 - 1. Test-Pressure Difference: [**2.86 lbf/sq. ft.**] [**6.24 lbf/sq. ft.**].
- G. Water Penetration under Dynamic Pressure: No water penetration when tested in accordance with AAMA 501.1 at the following test pressure:
 - 1. Test Pressure: [**6.24 psf**] [**12 psf**] [**15 psf**] <Insert pressure>.
- H. Pressure Cycling: Provide PER system with a pass rating in accordance with AAMA 508.
 - 1. Lag between the cavity and the cyclic wind pressure to not exceed 0.08 seconds.
 - 2. Maximum differential between the cavity and the cyclic wind pressure to not exceed 50 percent of the maximum test pressure.
- I. Provide DBVC system [**with V-axis classification number greater than or equal to W-axis classification number**] <Insert V-axis, W-axis> in accordance with AAMA 509.
- J. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: [**120 deg F, ambient; 180 deg F, material surfaces**] <Insert temperature range>.
- K. Fire-Resistance Ratings: Comply with ASTM E119 or UL 263; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Indicate design designations from UL's "Fire Resistance Directory" or from listings of another qualified testing agency.
- L. Fire Propagation Characteristics: MCM system passes NFPA 285 testing.

2.2 ACCESSORIES

- A. Metal Subframing and Furring: ASTM C955 cold-formed, metallic-coated steel sheet ASTM A653/A653M, **G90** hot-dip galvanized coating designation or ASTM A792/A792M, **Class AZ50** aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of MCM system.
- B. System Accessories: Provide components required for a complete, weathertight wall system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.
- C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, [**parapet caps,**] soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Use gasketed or approved coated fasteners between dissimilar metals.
 - 1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.
 - 2. Copper Panels: Use copper, stainless steel, or hardware-bronze fasteners.

3. Steel, Titanium, or Zinc Panels: Use stainless steel fasteners.
 4. Provide exposed fasteners with heads matching color of MCM panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM system manufacturer.

2.3 FABRICATION

- A. Fabricate and finish MCM panels at the factory, by panel manufacturer's standard procedures and processes, as necessary to fulfill indicated panel performance requirements demonstrated by laboratory testing.
- B. Shop-fabricate MCM systems and accessories by fabricator's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with requirements of MCM panel manufacturer, of indicated system profiles, and with dimensional and structural requirements.
1. Fabricate panels to dimensions indicated on Drawings based on an assumed design temperature of **70 deg F**. Allow for ambient temperature range at time of fabrication.
 2. Formed MCM panel lines, breaks, and angles to be sharp and straight, with surfaces free from warp or buckle.
 3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.
 4. Fabricated Panel Tolerances: Shop-fabricate panels to sizes and joint configurations indicated on Drawings.
 - a. Width: Plus or minus **0.079 inch** at **70 deg F**.
 - b. Length: Plus or minus **0.079 inch** at **70 deg F**.
 - c. Squareness: Plus or minus **0.079 inch** at **70 deg F**.
 5. Fabricate MCM panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
 6. Attach routed-and-turned panel flanges to **[perimeter extrusions]** **[panel clips]** with manufacturer's standard **[fasteners]** **[structural silicone adhesive]**.
- C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams.
 4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
 5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
 6. Fabricate cleats and attachment devices from same material as accessory being anchored

- or from compatible, noncorrosive metal recommended in writing by metal manufacturer.
- a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal manufacturer for application, but not less than thickness of metal being secured.

2.4 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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.
- C. Coil-Coated Metal Finish:
 1. PVDF Fluoropolymer: AAMA 2605, **[two-coat] [three-coat] [two-coat, with suspended mica flakes,] [three-coat, with suspended metallic flakes,]** fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat **[and clear topcoat]**. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 2. FEVE Fluoropolymer: AAMA 2605, **[one-coat] [two-coat] [three-coat] [two-coat, with suspended mica flakes,] [three-coat, with suspended metallic flakes,]** fluoropolymer finish containing 100 percent FEVE resin in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
- D. Anodized Aluminum Finish: **[Clear] [Color]** in accordance with AAMA 611, **[AA-M12C22A41, Class I, 0.018 mm] [AA-M12C22A31, Class II, 0.010 mm]** or thicker.
- E. Copper Finish: **[Mill] [Factory prepatinated in accordance with ASTM B882 with the appearance and durability of naturally formed patina] <Insert finish>**.
- F. Steel Finish, Stainless: Grind and polish surfaces to produce uniform finish in accordance with ASTM A480/480M, free of cross scratches. **[Run grain of directional finishes with long dimension of each piece.]**
 1. Finish Pattern: **[No. 4 polished] [No. 6 dull satin] [No. 7 high luster] [No. 8 mirror] <Insert finish>**.
- G. Steel Finish, Weathering: **[Natural] <Insert finish>**.
- H. Titanium Finish: **[Mill] [Reflective polished] <Insert finish>**.
- I. Zinc Finish, Prepatinated: **[Matte gray] [Dark black] [Colored mineral glaze] <Insert finish>**.
- J. Zinc Titanium Finish: ASTM B69 **[Type 1, blue-gray patina] [Type 1, bright rolled zinc] [Type 2, graphite-gray]**.
- K. Custom finish of **[aluminum] [copper] [steel] [titanium] [zinc]** by **<Insert name of finisher>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM system supports, and other conditions affecting performance of the Work.
 - 1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM system manufacturer.
 - 2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM system manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and assemblies penetrating MCM system to verify actual locations of penetrations relative to seam locations of MCM panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MCM SYSTEM

- A. General: Install MCM system in accordance with system manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM system securely in place, with provisions for thermal and structural movement.
 - 1. Shim or otherwise plumb substrates receiving MCM system.
 - 2. Flash and seal MCM system at perimeter of all openings. Fasten with self-tapping screws.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as MCM system work proceeds.
 - 6. Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 7. Provide weathertight escutcheons for all items penetrating system.
 - 8. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action [**with gaskets**] [**as recommended in writing by MCM system manufacturer**].
 - 9. Attach MCM panels to supports at locations, spacings, and with fasteners recommended by manufacturer to meet listed performance requirements.
- B. Attachment Assembly, General: Install attachment assembly required to support MCM panels and to provide a complete weathertight wall system, including tracks, drainage channels, anchor channels, perimeter extrusions[, and panel clips].
 - 1. Install subframing, furring, and other panel support members and anchorages in accordance with ASTM C955.
 - 2. Install support system at locations, at spacings, and with fasteners recommended by MCM system manufacturer to meet listed performance requirements.
- C. PER MCM System: Install vertical [**tracks**] [**drain channels**] and horizontal [**tracks**] [**channels**] providing compartmentalization at locations, at spacings, and with fasteners

recommended by system manufacturer.

1. Attach MCM panels by interlocking panel **[clips]** **[perimeter extrusion]** into **[tracks]** **[channels]** **[in a sequential series]**.
 2. Insert matching MCM spline into **[tracks]** **[channels]** at joint reveal locations.
- D. DBVC MCM System: Install vertical **[tracks]** **[drain channels]** and horizontal **[tracks]** **[channels]** at locations, at spacings, and with fasteners recommended by system manufacturer.
1. Attach MCM panels by interlocking panel **[clips]** **[perimeter extrusion]** into **[tracks]** **[channels]** **[in a sequential series]**.
 2. Insert matching MCM spline into **[tracks]** **[channels]** at joint reveal locations.
- E. Dry-Seal MCM System: Attach MCM panels by interlocking panel **[clips]** **[perimeter extrusion]** into **[tracks]** **[channels]** **[in a sequential series]**.
1. Seal horizontal and vertical joints between adjacent MCM panels with manufacturer's standard gaskets.
- F. Wet-Seal MCM System: Attach MCM panels by interlocking panel **[clips]** **[perimeter extrusion]** into **[tracks]** **[channels]** **[in a sequential series]**.
1. Seal horizontal and vertical joints between adjacent MCM panels with sealant backing and sealant in accordance with requirements specified in Section 079200 "Joint Sealants."
- G. Install panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.
- H. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
1. Install accessory components required for a complete MCM system assembly including trim, copings, corners, seam covers, flashings, **[sealants]** **[gaskets]**, fillers, closure strips, and similar items. Provide types indicated by MCM system manufacturer.
- I. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install trim to fit substrates and to result in waterproof performance.
 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of **10 ft.** with no joints allowed within **24 inches** of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with mastic sealant (concealed within joints).
- 3.3 INSTALLATION TOLERANCES
- A. Shim and align MCM panels within installed tolerance of **1/4 inch in 20 ft.**, non-accumulative, on level, plumb, and location lines as indicated, and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
- B. Water-Spray Test: After installation, test area of assembly **[indicated on Drawings]** **[as directed by Architect]** **<Insert area>** for water penetration in accordance with AAMA 501.2.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect completed MCM system installation, including accessories.
- D. MCM system will be considered defective if it does not pass test and inspections.
- E. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 CLEANING

- A. Remove temporary protective coverings and strippable films as MCM panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.
- B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

3.6 PROTECTION

- A. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 074213.23

SECTION 074616 - ALUMINUM SIDING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 COORDINATION

- A. Coordinate siding installation with flashings and other adjoining construction to ensure proper sequencing.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data:

1. Aluminum siding.
2. Aluminum soffit.

- B. Product Data Submittals: [**Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.**]

- C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

- D. Samples for Initial Selection: For aluminum **[siding]** **[and]** **[soffit]** including related accessories.

- E. Samples for Verification:[**For each type, color, texture, and pattern required.**]

1. **12-inch-** long-by-actual-width Sample of siding.
2. **24-inch-** wide-by-**36-inch-** high Sample panel of siding assembled on plywood backing.
3. **12-inch-** long-by-actual-width Sample of soffit.
4. **12-inch-** long-by-actual-width Samples of trim and accessories.

1.5 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of aluminum **[siding]** **[and]** **[soffit]**.

- B. Research/Evaluation Reports: For each type of aluminum siding required, from ICC-ES.

- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of product, including related accessories, to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish full lengths of aluminum **[siding]** **[and]** **[soffit]** including related accessories, in

a quantity equal to 2 percent of amount installed.

1.8 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical wall area as shown on Drawings.
 - 2. Build mockups for [siding] [and] [soffit] including accessories.
 - a. Size: [48 inches long by 60 inches high] <Insert dimensions>.
 - b. Include outside corner on one end of mockup[and inside corner on other end].
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with labels intact until time of use.
- B. Store materials on elevated platforms, under cover, and in a dry location.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including cracking[, fading,] and deforming.
 - b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - c. <Insert failure modes>.
 - 2. Fading is defined as loss of color, after cleaning with product recommended by manufacturer, of more than [4] [5] [7] Hunter color-difference units as measured in accordance with ASTM D2244.
 - 3. Warranty Period: [10] [25] [50] <Insert number> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain products, including related accessories, from single source from single manufacturer.

2.2 ACCESSORIES

- A. Siding Accessories, General: Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
 - 1. Provide accessories [made from same material as] [matching color and texture of] adjacent siding unless otherwise indicated.
- B. Aluminum Accessories: Where aluminum accessories are indicated, provide accessories complying with AAMA 1402.
 - 1. Texture: [Smooth] [Wood grain] <Insert requirement>.
 - 2. Nominal Thickness: [0.019 inch] [0.024 inch] <Insert dimension>.
 - 3. Finish: Manufacturer's standard [three-coat PVDF] [primer and baked-on acrylic] [primer and baked-on polyester] <Insert requirement>.

- C. Decorative Accessories: Provide the following aluminum decorative accessories as indicated:
1. Corner posts[**with fluted faces**].
 2. Door and window casings[**with fluted faces**].
 3. Entrance and window head pediments.
 4. Pilasters[**with fluted faces**].
 5. Shutters with [paneled] [louvered] faces.
 6. Louvers.
 7. Fasciae.
 8. Moldings and trim.
 9. <Insert accessories>.
- D. Colors for Decorative Accessories: [As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range of colors] [Match adjacent siding].
- E. Flashing: Provide aluminum flashing complying with Section 076200 "Sheet Metal Flashing and Trim" at window and door heads and where indicated.
1. Finish for Aluminum Flashing: [Same as aluminum siding] [Siliconized polyester coating, same color as siding] [High-performance organic finish, same color as siding] [Factory-prime coating] <Insert finish>.
- F. Fasteners:
1. For fastening to wood, use [siding nails] [ribbed bugle-head screws] of sufficient length to penetrate a minimum of **1 inch** into substrate.
 2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of **1/4 inch**, or three screw-threads, into substrate.
 3. For fastening aluminum, use aluminum fasteners. Where fasteners are exposed to view, use prefinished aluminum fasteners in color to match item being fastened.
- G. Insect Screening for Soffit Vents: [Aluminum, **18-by-16 mesh**] [PVC-coated, glass-fiber fabric, **18-by-14 or 18-by-16 mesh**] <Insert requirement>.
- H. Continuous Soffit Vents: Aluminum, hat-channel shape, with [stamped louvers] [perforations]; **2 inches** wide and not less than **96 inches** long.
1. Net-Free Area: [**4 sq. in./linear ft.**] [**6 sq. in./linear ft.**] [**8 sq. in./linear ft.**] <Insert dimension>.
 2. Finish: [Mill finish] [White paint] [Brown paint] <Insert requirement>.
- I. Round Soffit Vents: Stamped aluminum louvered vents, [**2 inches**] [**2-1/2 inches**] [**3 inches**] [**4 inches**] <Insert dimension> in diameter, made to be inserted in round holes cut into soffit.
1. Finish: [Mill finish] [White paint] [Brown paint] <Insert requirement>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance of aluminum [siding] [and] [soffit] and related accessories.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
 - 1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.
- B. Install aluminum [siding] [and] [soffit] and related accessories in accordance with AAMA 1402.
 - 1. Install fasteners no more than [24 inches] <Insert dimension> o.c.
- C. Install joint sealants as specified in Section 079200 "Joint Sealants" and to produce a weathertight installation.
- D. Where aluminum siding contacts dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.

3.4 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces in accordance with manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 074616

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof-drainage sheet metal fabrications.
2. Low-slope roof sheet metal fabrications.
3. Steep-slope roof sheet metal fabrications.
4. Wall sheet metal fabrications.
5. Miscellaneous sheet metal fabrications.

B. Related Requirements:

1. Section 061000 "Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section <Insert Section number> "<Insert Section title>" for [materials and] installation of manufactured sheet metal through-wall flashing and trim integral with masonry.
3. Section <Insert Section number> "<Insert Section title>" for [materials and] installation of sheet metal flashing and trim integral with roofing.
4. Section <Insert Section number> "<Insert Section title>" for sheet metal flashing and trim integral with metal wall panels.
5. Section 077100 "Roof Specialties" for manufactured copings, roof-edge specialties, roof-edge drainage systems, reglets, and counterflashings.
6. Section 077200 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
7. Section 079513.13 "Interior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for interior floors, walls, and ceilings.
8. Section 079513.16 "Exterior Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies for exterior building walls, soffits, and parapets.
9. Section 079513.19 "Parking Deck Expansion Joint Cover Assemblies" for manufactured expansion-joint cover assemblies subject to vehicular traffic.

1.2 COORDINATION

- A.** Coordinate sheet metal flashing and trim layout and seams with sizes and locations of penetrations to be flashed, and joints and seams in adjacent materials.
- B.** Coordinate sheet metal flashing and trim installation with adjoining roofing and wall materials, joints, and seams to provide leakproof, secure, and noncorrosive installation.

1.3 PREINSTALLATION MEETINGS

- A.** Preinstallation Conference: Conduct conference at [Project site] <Insert location>.
1. Review construction schedule. Verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review special roof details, roof drainage, roof-penetration flashing, equipment curbs, and condition of other construction that affect sheet metal flashing and trim.
 3. Review requirements for insurance and certificates if applicable.
 4. Review sheet metal flashing observation and repair procedures after flashing installation.

1.4 ACTION SUBMITTALS

- A.** Product Data:

1. Roof-drainage sheet metal fabrications.
 2. Low-slope roof sheet metal fabrications.
 3. Steep-slope roof sheet metal fabrications.
 4. Wall sheet metal fabrications.
 5. Miscellaneous sheet metal fabrications.
- B. Product Data Submittals:
1. Underlayment materials.
 2. Elastomeric sealant.
 3. Butyl sealant.
 4. Epoxy seam sealer.
- C. Sustainable Design Submittals:
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
- D. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
 2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
 3. Include identification of material, thickness, weight, and finish for each item and location in Project.
 4. Include details for forming, including profiles, shapes, seams, and dimensions.
 5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 6. Include details of termination points and assemblies.
 7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
 8. Include details of roof-penetration flashing.
 9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
 10. Include details of special conditions.
 11. Include details of connections to adjoining work.
 12. Detail formed flashing and trim at scale of not less than [**1-1/2 inches per 12 inches**] [**3 inches per 12 inches**] <Insert scale>.
- E. Samples: For each exposed product and for each color and texture specified, **12 inches** long by actual width.
- F. Samples for Initial Selection: For each type of sheet metal and accessory indicated with factory-applied finishes.
- G. Samples for Verification: For each type of exposed finish.
1. Sheet Metal Flashing: **12 inches** long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 2. Trim, Metal Closures, Expansion Joints, Joint Intersections, and Miscellaneous Fabrications: **12 inches** long and in required profile. Include fasteners and other exposed accessories.
 3. Unit-Type Accessories and Miscellaneous Materials: Full-size Sample.
 4. Anodized Aluminum Samples: Samples to show full range to be expected for each color

required.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Product Certificates: For each type of coping and roof edge flashing that is **[ANSI/SPRI/FM 4435/ES-1 tested] [and] [FM Approvals approved]**.
- C. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- D. Evaluation Reports: For copings and roof edge flashing, from **[an agency acceptable to authority having jurisdiction] [ICC-ES] <Insert evaluation agency>** showing compliance with ANSI/SPRI/FM 4435/ES-1.
- E. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing and trim, and its accessories, to include in maintenance manuals.
- B. Special warranty.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
 - 1. For copings and roof edge flashings that are ANSI/SPRI/FM 4435/ES-1 tested **[and FM Approvals approved]**, shop is to be listed as able to fabricate required details as tested and approved.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for fabrication and installation.
 - 1. Build mockup of typical roof **[edge] [eave]**, including **[built-in gutter] [fascia] [fascia trim] [apron flashing] <Insert item>**, approximately **[10 feet] <Insert dimension>** long, including supporting construction cleats, seams, attachments, **[underlayment]**, and accessories.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.
 - 1. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
 - 2. Protect stored sheet metal flashing and trim from contact with water.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to extent necessary for period of sheet metal flashing and

trim installation.

1.9 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
 - 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - 2. Finish Warranty Period: **[20] [10] <Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, are to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim are not to rattle, leak, or loosen, and are to remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with **[NRCA's "The NRCA Roofing Manual: Architectural Metal Flashing, Condensation and Air Leakage Control, and Reroofing"] [and] [SMACNA's "Architectural Sheet Metal Manual"]** requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. SPRI Wind Design Standard: Manufacture and install **[copings] [roof edge flashings]** tested in accordance with ANSI/SPRI/FM 4435/ES-1 and capable of resisting the following design pressure:
 - 1. Design Pressure: **[As indicated on Drawings] <Insert design pressure>**.
- E. FM Approvals Listing: Manufacture and install **[copings] [roof edge flashings]** that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, **[Class 1-60] [Class 1-75] [Class 1-90] [Class 1-105] [Class 1-120] <Insert class>**. Identify materials with name of fabricator and design approved by FM Approvals.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - 1. Temperature Change: **[120 deg F, ambient; 180 deg F, material surfaces] <Insert temperature change>**.

2.2 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry,

metal thickness, and other characteristics of item required.

1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabrication Tolerances:

1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of **1/4 inch in 20 feet** on slope and location lines indicated on Drawings and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.
2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard[**and by FM Global Property Loss Prevention Data Sheet 1-49**] for application, but not less than thickness of metal being secured.

G. Seams:

1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use.[**Rivet joints where necessary for strength.**]
3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer.[**Rivet joints where necessary for strength.**]

H. Do not use graphite pencils to mark metal surfaces.

2.3 ROOF-DRAINAGE SHEET METAL FABRICATIONS

A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other

- accessories as required.
2. Fabricate in minimum **96-inch**- long sections.
 3. Furnish flat-stock gutter brackets and **[flat-stock] [twisted]** gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than **[twice the gutter thickness] [dimension indicated on Drawings] <Insert dimension>**.
 4. Fabricate expansion joints, expansion-joint covers, **[gutter bead reinforcing bars,]** and gutter accessories from same metal as gutters. **[Shop fabricate interior and exterior corners.]**
 5. Gutter Profile: **[Style A] [Style B] [Style C] [Style D] [Style E] [Style F] [Style G] [Style H] [Style I] [Style J] [Style K] [Style L]** in accordance with cited sheet metal standard.
 6. Expansion Joints: **[Lap type] [Butt type] [Butt type with cover plate] [Built in]**.
 7. Accessories: **[Continuous, removable leaf screen with sheet metal frame and hardware cloth screen] [Wire-ball downspout strainer] [Valley baffles]**.
 8. Gutters with Girth up to 15 Inches (380 mm): Fabricate from the following materials:
 - a. Copper: **[16 oz./sq. ft.] <Insert value>**.
 - b. Aluminum: **[0.032 inch] <Insert dimension>** thick.
 - c. Stainless Steel: **[0.0156 inch] <Insert dimension>** thick.
 - d. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft.] <Insert value>**.
 - e. Galvanized Steel: **[0.022 inch] <Insert dimension>** thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: **[0.022 inch] <Insert dimension>** thick.
 - g. Zinc: **[0.032 inch] [0.039 inch] <Insert dimension>** thick.
 - h. Copper-Clad Stainless Steel: **[0.016 inch] <Insert dimension>** thick.
 9. Gutters with Girth 16 to 20 Inches (410 to 510 mm): Fabricate from the following materials:
 - a. Copper: **[16 oz./sq. ft.] <Insert value>**.
 - b. Aluminum: **[0.040 inch] <Insert dimension>** thick.
 - c. Stainless Steel: **[0.0188 inch] <Insert dimension>** thick.
 - d. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft.] <Insert value>**.
 - e. Galvanized Steel: **[0.028 inch] <Insert dimension>** thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: **[0.028 inch] <Insert dimension>** thick.
 - g. Zinc: **[0.039 inch] [0.048 inch] <Insert dimension>** thick.
 - h. Copper-Clad Stainless Steel: **[0.018 inch] <Insert dimension>** thick.
 10. Gutters with Girth 21 to 25 Inches (530 to 640 mm): Fabricate from the following materials:
 - a. Copper: **[20 oz./sq. ft.] <Insert value>**.
 - b. Aluminum: **[0.050 inch] <Insert dimension>** thick.
 - c. Stainless Steel: **[0.0250 inch] <Insert dimension>** thick.
 - d. Zinc-Tin Alloy-Coated Copper: **[20 oz./sq. ft.] <Insert value>**.
 - e. Galvanized Steel: **[0.034 inch] <Insert dimension>** thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: **[0.034 inch] <Insert dimension>** thick.
 - g. Zinc: **[0.048 inch] [0.059 inch] <Insert dimension>** thick.
 - h. Copper-Clad Stainless Steel: **[0.027 inch] <Insert dimension>** thick.
 11. Gutters with Girth 26 to 30 Inches (660 to 760 mm): Fabricate from the following materials:
 - a. Copper: **[24 oz./sq. ft.] <Insert value>**.
 - b. Aluminum: **[0.063 inch] <Insert dimension>** thick.
 - c. Stainless Steel: **[0.0313 inch] <Insert dimension>** thick.

- d. Zinc-Tin Alloy-Coated Copper: [24 oz./sq. ft.] <Insert value>.
 - e. Galvanized Steel: [0.040 inch] <Insert dimension> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [0.040 inch] <Insert dimension> thick.
12. Gutters with Girth 31 to 35 Inches (790 to 890 mm): Fabricate from the following materials:
- a. Copper: [24 oz./sq. ft.] <Insert value>.
 - b. Stainless Steel: [0.0375 inch] <Insert dimension> thick.
 - c. Zinc-Tin Alloy-Coated Copper: [25 oz./sq. ft.] <Insert value>.
 - d. Galvanized Steel: [0.052 inch] <Insert dimension> thick.
 - e. Aluminum-Zinc Alloy-Coated Steel: [0.052 inch] <Insert dimension> thick.
- B. Built-in Gutters:
1. Fabricate to cross section required, with riveted and soldered joints, complete with end pieces, outlet tubes, and other special accessories as required.
 2. Fabricate in minimum 96-inch- long sections. Fabricate expansion joints and accessories from same metal as gutters unless otherwise indicated.
 3. Fabricate gutters with built-in expansion joints[and gutter-end expansion joints at walls].
 4. Accessories: [Continuous, removable leaf screen with sheet metal frame and hardware cloth screen] [Bronze wire-ball downspout strainer] [Wire-ball downspout strainer].
 5. Fabricate from the following materials:
 - a. Copper: [16 oz./sq. ft.] <Insert value>.
 - b. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 - c. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 - d. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 - e. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- C. Downspouts: Fabricate [round] [rectangular] [open-face] downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from [same material as downspouts and anchors] <Insert material>.[Shop fabricate elbows.]
1. Fabricated Hanger Style: [Fig. 1-35A] [Fig. 1-35B] [Fig. 1-35C] [Fig. 1-35D] [Fig. 1-35E] [Fig. 1-35F] [Fig. 1-35G] [Fig. 1-35H] [Fig. 1-35I] [Fig. 1-35J] in accordance with SMACNA's "Architectural Sheet Metal Manual."
 2. Manufactured Hanger Style: [Fig. 1-34A] [Fig. 1-34B] [Fig. 1-34C] [Fig. 1-34D] [Fig. 1-34E] in accordance with SMACNA's "Architectural Sheet Metal Manual."
 3. Hanger Style: <Insert description>.
 4. Fabricate from the following materials:
 - a. Copper: [16 oz./sq. ft.] <Insert value>.
 - b. Aluminum: [0.024 inch] <Insert dimension> thick.
 - c. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 - e. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 - g. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 - h. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- D. Parapet Scuppers: Fabricate scuppers to dimensions required, with closure flange trim to exterior, 4-inch- wide wall flanges to interior, and base extending 4 inches beyond cant or tapered strip into field of roof.[Fasten gravel guard angles to base of scupper.] Fabricate

from the following materials:

1. Copper: [16 oz./sq. ft.] <Insert value>.
2. Aluminum: [0.032 inch] <Insert dimension> thick.
3. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
5. Galvanized Steel: [0.028 inch] <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert dimension> thick.
7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
8. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.

- E. Conductor Heads: Fabricate conductor heads with flanged back and stiffened top edge and of dimensions and shape required, complete with outlet tubes[, exterior flange trim,] [and] [built-in overflows]. Fabricate from the following materials:

1. Copper: [16 oz./sq. ft.] <Insert value>.
2. Aluminum: [0.032 inch] <Insert dimension> thick.
3. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
5. Galvanized Steel: [0.028 inch] <Insert dimension> thick.
6. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert dimension> thick.
7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
8. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.

- F. Splash Pans: Fabricate to dimensions and shape required and from the following materials:

1. Copper: [16 oz./sq. ft.] <Insert value>.
2. Aluminum: [0.040 inch] <Insert dimension> thick.
3. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
5. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
6. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.

2.4 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Cap: Fabricate in minimum 96-inch- long, but not exceeding 12-foot- long sections. Furnish with 6-inch- wide, joint cover plates. [Shop fabricate interior and exterior corners.]

1. Joint Style: [Overlapped, 4 inches wide] [Butted with expansion space and 6-inch- wide, concealed backup plate] [Butted with expansion space and 6-inch- wide, exposed cover plate] <Insert description>.
2. Fabricate with scuppers spaced [10 feet] <Insert dimension> apart, to dimensions required with 4-inch- wide flanges and base extending 4 inches beyond cant or tapered strip into field of roof. Fasten gravel guard angles to base of scupper.
3. Fabricate from the following materials:
 - a. Copper: [20 oz./sq. ft.] <Insert value>.
 - b. Aluminum: [0.050 inch] <Insert dimension> thick.
 - c. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Copper: [20 oz./sq. ft.] <Insert value>.
 - e. Galvanized Steel: [0.028 inch] <Insert dimension> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert dimension> thick.
 - g. Zinc: [0.048 inch] [0.059 inch] <Insert dimension> thick.
 - h. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.

- B. Copings: Fabricate in minimum **96-inch** long, but not exceeding **12-foot** long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and[**drill elongated holes for fasteners on**] interior leg. Miter corners, [fasten and seal] [solder or weld] watertight.[**Shop fabricate interior and exterior corners.**]
1. Coping Profile: [Fig. 3-4A] [Fig. 3-4B] [Fig. 3-4C] [Fig. 3-4D] [Fig. 3-4E] [Fig. 3-4F] [Fig. 3-4G] in accordance with SMACNA's "Architectural Sheet Metal Manual."
 2. Joint Style: [Butted with expansion space and **6-inch** wide, concealed backup plate] [Butted with expansion space and **6-inch** wide, exposed cover plate] <Insert description>.
 3. Fabricate from the following materials:
 - a. Copper: [**24 oz./sq. ft.**] <Insert value>.
 - b. Aluminum: [**0.050 inch**] <Insert dimension> thick.
 - c. Stainless Steel: [**0.0250 inch**] <Insert dimension> thick.
 - d. Zinc-Tin Alloy-Coated Copper: [**24 oz./sq. ft.**] <Insert value>.
 - e. Galvanized Steel: [**0.040 inch**] <Insert dimension> thick.
 - f. Aluminum-Zinc Alloy-Coated Steel: [**0.040 inch**] <Insert dimension> thick.
 - g. Zinc: [**0.048 inch**] [**0.059 inch**] <Insert dimension> thick.
 - h. Copper-Clad Stainless Steel: [**0.027 inch**] <Insert dimension> thick.
- C. Expansion-Joint Cover: [**Shop fabricate interior and exterior corners.**] Fabricate [roof] [and] [roof-to-wall transition] [roof-to-roof edge-flashing (gravel-stop) transition] [roof-to-roof edge-flashing (gravel-stop) and fascia-cap transition] expansion-joint cover from the following materials:
1. Copper: [**16 oz./sq. ft.**] <Insert value>.
 2. Aluminum: [**0.050 inch**] <Insert dimension> thick.
 3. Stainless Steel: [**0.0250 inch**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft.**] <Insert value>.
 5. Galvanized Steel: [**0.034 inch**] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [**0.034 inch**] <Insert dimension> thick.
 7. Zinc: [**0.032 inch**] [**0.039 inch**] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [**0.027 inch**] <Insert dimension> thick.
- D. Base Flashing: [**Shop fabricate interior and exterior corners.**] Fabricate from the following materials:
1. Copper: [**20 oz./sq. ft.**] <Insert value>.
 2. Aluminum: [**0.040 inch**] <Insert dimension> thick.
 3. Stainless Steel: [**0.0188 inch**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [**20 oz./sq. ft.**] <Insert value>.
 5. Galvanized Steel: [**0.028 inch**] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [**0.028 inch**] <Insert dimension> thick.
 7. Zinc: [**0.032 inch**] [**0.039 inch**] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [**0.018 inch**] <Insert dimension> thick.
- E. Counterflashing: [**Shop fabricate interior and exterior corners.**] Fabricate from the following materials:
1. Copper: [**16 oz./sq. ft.**] <Insert value>.
 2. Aluminum: [**0.032 inch**] <Insert dimension> thick.
 3. Stainless Steel: [**0.0188 inch**] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [**16 oz./sq. ft.**] <Insert value>.

5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.
- F. Flashing Receivers: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Aluminum: [0.032 inch] <Insert dimension> thick.
 3. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 4. Galvanized Steel: [0.028 inch] <Insert dimension> thick.
 5. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert dimension> thick.
 6. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 7. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.
 8. Lead: [4 lb] <Insert weight>.
- H. Roof-Drain Flashing: Fabricate from the following materials:
1. Copper: [12 oz./sq. ft.] <Insert value>.
 2. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 3. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- 2.5 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS
- A. Apron, Step, Cricket, and Backer Flashing: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Aluminum: [0.032 inch] <Insert dimension> thick.
 3. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- B. Valley Flashing: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 4. Galvanized Steel: [0.028 inch] <Insert dimension> thick.
 5. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert dimension> thick.
 6. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 7. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.

- C. Drip Edges: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Aluminum: [0.032 inch] <Insert dimension> thick.
 3. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- D. Eave, Rake, Ridge, and Hip Flashing: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Aluminum: [0.032 inch] <Insert dimension> thick.
 3. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- E. Counterflashing: [Shop fabricate interior and exterior corners.] Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Aluminum: [0.032 inch] <Insert dimension> thick.
 3. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.
- F. Flashing Receivers: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Aluminum: [0.032 inch] <Insert dimension> thick.
 3. Stainless Steel: [0.0156 inch] <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 5. Galvanized Steel: [0.022 inch] <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: [0.022 inch] <Insert dimension> thick.
 7. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: [0.016 inch] <Insert dimension> thick.
- G. Roof-Penetration Flashing: Fabricate from the following materials:
1. Copper: [16 oz./sq. ft.] <Insert value>.
 2. Stainless Steel: [0.0188 inch] <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Copper: [16 oz./sq. ft.] <Insert value>.
 4. Galvanized Steel: [0.028 inch] <Insert dimension> thick.
 5. Aluminum-Zinc Alloy-Coated Steel: [0.028 inch] <Insert dimension> thick.
 6. Zinc: [0.032 inch] [0.039 inch] <Insert dimension> thick.
 7. Copper-Clad Stainless Steel: [0.018 inch] <Insert dimension> thick.

8. Lead: **[4 lb]** <Insert weight>.

2.6 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in minimum **96-inch**- long, but not exceeding **12-foot**- long, sections, under copings, and at shelf angles. Fabricate discontinuous lintel, sill, and similar flashings to extend **6 inches** beyond each side of wall openings; and form with **2-inch**- high, end dams. Fabricate from the following materials:
1. Copper: **[16 oz./sq. ft.]** <Insert value>.
 2. Stainless Steel: **[0.0156 inch]** <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft.]** <Insert value>.
 4. Zinc: **[0.032 inch]** **[0.039 inch]** <Insert dimension> thick.
 5. Copper-Clad Stainless Steel: **[0.016 inch]** <Insert dimension> thick.
- B. Opening Flashings in Frame Construction: Fabricate head, sill, **[jamb]**, and similar flashings to extend **[4 inches]** <Insert dimension> beyond wall openings. Form head and sill flashing with **2-inch**- high, end dams. Fabricate from the following materials:
1. Copper: **[16 oz./sq. ft.]** <Insert value>.
 2. Aluminum: **[0.032 inch]** <Insert dimension> thick.
 3. Stainless Steel: **[0.0156 inch]** <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft.]** <Insert value>.
 5. Galvanized Steel: **[0.022 inch]** <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: **[0.022 inch]** <Insert dimension> thick.
 7. Zinc: **[0.032 inch]** **[0.039 inch]** <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: **[0.016 inch]** <Insert dimension> thick.
- C. Wall Expansion-Joint Cover: Fabricate from the following materials:
1. Copper: **[16 oz./sq. ft.]** <Insert value>.
 2. Aluminum: **[0.040 inch]** <Insert dimension> thick.
 3. Stainless Steel: **[0.0188 inch]** <Insert dimension> thick.
 4. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft.]** <Insert value>.
 5. Galvanized Steel: **[0.028 inch]** <Insert dimension> thick.
 6. Aluminum-Zinc Alloy-Coated Steel: **[0.028 inch]** <Insert dimension> thick.
 7. Zinc: **[0.032 inch]** **[0.039 inch]** <Insert dimension> thick.
 8. Copper-Clad Stainless Steel: **[0.018 inch]** <Insert dimension> thick.

2.7 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
1. Copper: **[16 oz./sq. ft.]** <Insert value>.
 2. Stainless Steel: **[0.0188 inch]** <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Copper: **[16 oz./sq. ft.]** <Insert value>.
 4. Galvanized Steel: **[0.028 inch]** <Insert dimension> thick.
 5. Aluminum-Zinc Alloy-Coated Steel: **[0.028 inch]** <Insert dimension> thick.
 6. Copper-Clad Stainless Steel: **[0.018 inch]** <Insert dimension> thick.
- B. Overhead-Piping Safety Pans: Fabricate from the following materials:
1. Copper: **[24 oz./sq. ft.]** <Insert value>.
 2. Stainless Steel: **[0.0250 inch]** <Insert dimension> thick.
 3. Zinc-Tin Alloy-Coated Copper: **[24 oz./sq. ft.]** <Insert value>.
 4. Galvanized Steel: **[0.040 inch]** <Insert dimension> thick.
 5. Aluminum-Zinc Alloy-Coated Steel: **[0.040 inch]** <Insert dimension> thick.

6. Copper-Clad Stainless Steel: [**0.027 inch**] <Insert dimension> thick.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with installer present, for compliance with requirements for installation tolerances, substrate, and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
 - 3. Verify that air- or water-resistant barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF UNDERLAYMENT

- A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lap joints not less than **2 inches**.
- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
 - 1. Lap horizontal joints not less than **4 inches**.
 - 2. Lap end joints not less than **12 inches**.
- C. Self-Adhering, High-Temperature Sheet Underlayment:
 - 1. Install self-adhering, high-temperature sheet underlayment; wrinkle free.
 - 2. Prime substrate if recommended by underlayment manufacturer.
 - 3. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures.
 - 4. Apply in shingle fashion to shed water, with end laps of not less than **6 inches** staggered **24 inches** between courses.
 - 5. Overlap side edges not less than **3-1/2 inches**. Roll laps and edges with roller.
 - 6. Roll laps and edges with roller.
 - 7. Cover underlayment within 14 days.
- D. Install slip sheet, wrinkle free, [**over underlayment**] [**directly on substrate**] <Insert requirement> before installing sheet metal flashing and trim.
 - 1. Install in shingle fashion to shed water.
 - 2. Lapp joints not less than **4 inches**.

3.3 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
 - 1. Install fasteners[, **solder**], protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat

- seams with minimum exposure of [solder] [welds] [sealant].
3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
 5. Install continuous cleats with fasteners spaced not more than **12 inches** o.c.
 6. Space individual cleats not more than **12 inches** apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
 8. Do not field cut sheet metal flashing and trim by torch.
 9. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
1. Coat concealed side of [uncoated-aluminum] [and] [stainless steel] sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
1. Space movement joints at maximum of [**10 feet**] <Insert dimension> with no joints within **24 inches** of corner or intersection.
 2. Form expansion joints of intermeshing hooked flanges, not less than **1 inch** deep, filled with sealant concealed within joints.
 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate [wood blocking or sheathing not less than **1-1/4 inches for nails and not less than 3/4 inch for wood screws**] [substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance] <Insert size requirement>.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
1. Use sealant-filled joints unless otherwise indicated.
 - a. Embed hooked flanges of joint members not less than **1 inch** into sealant.
 - b. Form joints to completely conceal sealant.
 - c. When ambient temperature at time of installation is between **40 and 70 deg F**, set joint members for 50 percent movement each way.
 - d. Adjust setting proportionately for installation at higher ambient temperatures.
 - 1) Do not install sealant-type joints at temperatures below **40 deg F**.
 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

- G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter.
1. Pretin edges of sheets with solder to width of **1-1/2 inches**; however, reduce pretinning where pretinned surface would show in completed Work.
 2. Do not solder **[metallic-coated steel]** **[and]** **[aluminum]** sheet.
 3. Do not pretin zinc-tin alloy-coated copper.
 4. Do not use torches for soldering.
 5. Heat surfaces to receive solder, and flow solder into joint.
 - a. Fill joint completely.
 - b. Completely remove flux and spatter from exposed surfaces.
 6. Stainless Steel Soldering:
 - a. Tin edges of uncoated sheets, using solder for stainless steel and acid flux.
 - b. Promptly remove acid-flux residue from metal after tinning and soldering.
 - c. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
 7. Copper Soldering: Tin edges of uncoated sheets, using solder for copper.
 8. Copper-Clad Stainless Steel Soldering: Tin edges of uncoated sheets, using solder for copper-clad stainless steel.

- H. Rivets: Rivet joints in **[uncoated aluminum]** **[zinc]** where necessary for strength.

3.4 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.
- B. Hanging Gutters:
1. Join sections with **[riveted and soldered joints]** **[or]** **[joints sealed with sealant]**.
 2. Provide for thermal expansion.
 3. Attach gutters at eave or fascia to firmly anchor them in position.
 4. Provide end closures and seal watertight with sealant.
 5. Slope to downspouts.
 6. Fasten gutter spacers to front and back of gutter.
 7. Anchor and loosely lock back edge of gutter to continuous **[cleat]** **[eave or apron flashing]**.
 8. Anchor back of gutter that extends onto roof deck with cleats spaced not more than **[24 inches]** **<Insert dimension>** apart.
 9. Anchor gutter with **[gutter brackets]** **[straps]** **[twisted straps]** spaced not more than **[24 inches]** **[30 inches]** **[36 inches]** **<Insert dimension>** apart to roof deck unless otherwise indicated, and loosely lock to front gutter bead.
 10. Anchor gutter with spikes and ferrules spaced not more than **[24 inches]** **[30 inches]** **<Insert dimension>** apart.
 11. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, **[50 feet]** **<Insert dimension>** apart. Install expansion-joint caps.
 12. Install continuous gutter screens on gutters with noncorrosive fasteners, **[removable]** **[hinged to swing open]** for cleaning gutters.
- C. Built-in Gutters:
1. Join sections with **[riveted and soldered joints]** **[or]** **[joints sealed with sealant]**.
 2. Provide for thermal expansion.

3. Slope to downspouts.
 4. Provide end closures and seal watertight with sealant.
 5. Install underlayment layer in built-in gutter trough and extend to drip edge at eaves and under underlayment on roof sheathing.
 - a. Lap sides minimum of **2 inches** over underlying course.
 - b. Lap ends minimum of **4 inches**.
 - c. Stagger end laps between succeeding courses at least **72 inches**.
 - d. Fasten with roofing nails.
 - e. Install slip sheet over underlayment.
 6. Anchor and loosely lock back edge of gutter to continuous **[cleat]** **[eave or apron flashing]**.
 7. Anchor back of gutter that extends onto roof deck with cleats spaced not more than **[18 inches]** **<Insert dimension>** apart.
 8. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, **[50 feet]** **<Insert dimension>** apart. Install expansion-joint caps.
- D. Downspouts:
1. Join sections with **1-1/2-inch** telescoping joints.
 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
 3. Locate hangers at top and bottom and at approximately **60 inches** o.c.
 4. Provide elbows at base of downspout to direct water away from building.
 5. Connect downspouts to underground drainage system.
- E. Splash Pans:
1. Install where downspouts discharge on **[low-slope roofs]** **<Insert surface>**.
 2. Set in **[asphalt roofing cement]** **[or]** **[elastomeric sealant]** compatible with the substrate.
- F. Parapet Scuppers:
1. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
 2. Anchor scupper closure trim flange to exterior wall and **[solder]** **[or]** **[seal with elastomeric sealant]** to scupper.
 3. Loosely lock front edge of scupper with conductor head.
 4. **[Solder]** **[or]** **[seal with elastomeric sealant]** exterior wall scupper flanges into back of conductor head.
- G. Conductor Heads: Anchor securely to wall, with elevation of conductor head rim at minimum of **1 inch** below **[scupper]** **[or]** **[gutter]** discharge.
- H. Expansion-Joint Covers: Install expansion-joint covers at locations and of configuration indicated on Drawings. Lap joints minimum of **4 inches** in direction of water flow.

3.5 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements[, **sheet metal manufacturer's written installation instructions,**] and cited sheet metal standard.
1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at [staggered **3-inch**] **<Insert spacing>** centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

C. Copings:

1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated.
 - a. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at [**24-inch**] [**16-inch**] **<Insert dimension>** centers.
 - b. Anchor interior leg of coping with washers and screw fasteners through slotted holes at [**24-inch**] **<Insert dimension>** centers.
3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for specified FM Approvals' listing for required windstorm classification.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of **4 inches** over base flashing. Install stainless steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing.

1. Insert counterflashing in reglets or receivers and fit tightly to base flashing.
2. Extend counterflashing **4 inches** over base flashing.
3. Lap counterflashing joints minimum of **4 inches**.
4. Secure in waterproof manner by means of [**snap-in installation and sealant or lead wedges and sealant**] [**interlocking folded seam or blind rivets and sealant**] [anchor and washer spaced at **12 inches o.c. along perimeter and 6 inches o.c. at corners areas**] **<Insert requirement>** unless otherwise indicated.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with [**elastomeric**] [**butyl**] sealant and clamp flashing to pipes that penetrate roof.

3.6 INSTALLATION OF WALL FLASHINGS

- A. Install sheet metal wall flashing to intercept and exclude penetrating moisture in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Opening Flashings in Frame Construction: Install continuous head, sill, [**jamb**], and similar flashings to extend [**4 inches**] **<Insert dimension>** beyond wall openings.
- C. Reglets: Installation of reglets is specified in [**Section 033000 "Cast-in-Place Concrete."**] [**Section 042000 "Unit Masonry."**] Section **<Insert Section number>** "**<Insert Section title>**."

3.7 INSTALLATION OF MISCELLANEOUS FLASHING

- A. Equipment Support Flashing:
 - 1. Coordinate installation of equipment support flashing with installation of roofing and equipment.
 - 2. Weld or seal flashing with elastomeric sealant to equipment support member.
- B. Overhead-Piping Safety Pans:
 - 1. Suspend pans from structure above, independent of other overhead items such as equipment, piping, and conduit, unless otherwise indicated on Drawings.
 - 2. Pipe and install drain line to plumbing waste or drainage system.

3.8 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of **1/4 inch in 20 feet** on slope and location lines indicated on Drawings and within **1/8-inch** offset of adjoining faces and of alignment of matching profiles.

3.9 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

3.10 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. On completion of sheet metal flashing and trim installation, remove unused materials and clean finished surfaces as recommended in writing by sheet metal flashing and trim manufacturer.
- C. Maintain sheet metal flashing and trim in clean condition during construction.
- D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

- C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in **1/2-inch-** wide joints formed between two **6-inch-** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

- D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

1. Joint-sealant location and designation.
2. Manufacturer and product name.
3. Type of substrate material.
4. Proposed test.
5. Number of samples required.

- B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 MOCKUPS

- A. Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
 - 2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
 - 3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with [stone] [masonry] <Insert substrate> substrates.
 - 4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
 - 5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
 - 6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
 - 7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
 - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
 - 2. Conduct field tests for each kind of sealant and joint substrate.

3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.9 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer[or are below **40 deg F**].
 2. When joint substrates are wet.
 3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
 4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.10 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: [**Two**] <Insert number> years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: [**Five**] <Insert number> years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer[**for each sealant type**].

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: **[As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range].**

2.3 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 - d. Exterior insulation and finish systems.
 - e. **<Insert other porous joint substrate>.**
 - 3. Remove laitance and form-release agents from concrete.
 - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint

sealants. Nonporous joint substrates include the following:

- a. Metal.
- b. Glass.
- c. Porcelain enamel.
- d. Glazed surfaces of ceramic tile.
- e. **<Insert other nonporous joint substrate>.**

- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 1. Do not leave gaps between ends of sealant backings.
 2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
 1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
 1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless

- otherwise indicated.
4. Provide flush joint profile at **[locations indicated on Drawings]** <Insert locations> in accordance with Figure 8B in ASTM C1193.
 5. Provide recessed joint configuration of recess depth and at **[locations indicated on Drawings]** <Insert locations> in accordance with Figure 8C in ASTM C1193.
 - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.
- 3.4 **FIELD QUALITY CONTROL**
- A. Testing Agency: **[Owner will engage]** **[Engage]** a qualified testing agency to perform tests and inspections.
 - B. Tests and Inspections:
 1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform **[10]** <Insert number> tests for the first **[1000 ft.]** <Insert dimension> of joint length for each kind of sealant and joint substrate.
 - 2) Perform one test for each **[1000 ft.]** <Insert dimension> of joint length thereafter or one test per each floor per elevation.
 - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.
 - 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
 2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
 - C. Prepare test and inspection reports.
- 3.5 **CLEANING**
- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of

products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Interior custom hollow-metal doors and frames.
4. Exterior custom hollow-metal doors and frames.

B. Related Requirements:

1. Section 081119 "Stainless-Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
2. Section 083473.13 "Metal Sound Control Door Assemblies" for packaged, acoustically rated hollow-metal door and frame assemblies.
3. **[Section 087100 "Door Hardware"] [Section 087111 "Door Hardware (Descriptive Specification)"]** for door hardware for hollow-metal doors.
4. Section 119812 "Detention Doors and Frames" for hollow-metal doors and frames for detention facilities.
5. Section 134900 "Radiation Protection" for lead-lined, hollow-metal doors and frames.

1.2 DEFINITIONS

- A. Minimum Thickness:** Minimum thickness of base metal without coatings in accordance with NAAMM-HMMA 803 or ANSI/SDI A250.8.

1.3 COORDINATION

- A.** Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B.** Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

A. Product Data:

1. Interior standard steel doors and frames.
2. Exterior standard steel doors and frames.
3. Interior custom hollow-metal doors and frames.
4. Exterior custom hollow-metal doors and frames.

B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, core descriptions, **[fire-resistance ratings,]** **[temperature-rise ratings,]** and finishes.

C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled

- content and cost.
 - 2. Environmental Product Declaration: For each product.
 - 3. Health Product Declaration: For each product.
 - 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 - 5. Environmental Product Declaration: For each product.
 - 6. Environmental Product Declaration: For each product.
 - 7. Environmental Product Declaration: For each product.
 - 8. Third-Party Certifications: For each product.
 - 9. Third-Party Certified Life Cycle Assessment: For each product.
- D. Shop Drawings: Include the following:
- 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 - 7. Details of anchorages, joints, field splices, and connections.
 - 8. Details of accessories.
 - 9. Details of moldings, removable stops, and glazing.
- E. Samples for Initial Selection: For hollow-metal doors and frames with factory-applied color finishes.
- F. Samples for Verification:
- 1. Finishes: For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches**.
 - 2. Fabrication: Prepare Samples approximately [**12 by 12 inches**] [**8 by 10 inches**] <Insert dimension> to demonstrate compliance with requirements for quality of materials and construction:
 - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
 - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow-metal panels and glazing if applicable.
- G. Product Schedule: For hollow-metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For door inspector.
- 1. Fire-Rated Door Inspector: Submit documentation of compliance with NFPA 80, Section 5.2.3.1.
 - 2. Egress Door Inspector: Submit documentation of compliance with NFPA 101, Section 7.2.1.15.4.
 - 3. Submit copy of DHI Fire and Egress Door Assembly Inspector (FDAI) certificate.
- B. Product Test Reports: For each type of [**fire-rated hollow-metal door and frame assembly**]

[**fire-rated borrowed-lite assembly**] [**windborne-debris impact resistance door**] [**and**]
[**thermally rated door assemblies**] for tests performed by a qualified testing agency indicating compliance with performance requirements.

- C. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.
- D. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

- A. Record Documents: For fire-rated doors, list of door numbers and applicable room name and number to which door accesses.

1.8 QUALITY ASSURANCE

- A. Fire-Rated Door Inspector Qualifications: Inspector for field quality-control inspections of fire-rated door assemblies is to meet the qualifications set forth in NFPA 80, Section 5.2.3.1 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.
- B. Egress Door Inspector Qualifications: Inspector for field quality-control inspections of egress door assemblies is to meet the qualifications set forth in NFPA 101, Section 7.2.1.15.4 and the following:
 - 1. Door and Hardware Institute Fire and Egress Door Assembly Inspector (FDAI) certification.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow-metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal doors and frames vertically under cover at Project site with head up. Place on minimum **4-inch** high wood blocking. Provide minimum **1/4-inch** space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings[**and temperature-rise limits**] indicated on Drawings, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Door Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that doors comply with standard

- construction requirements for tested and labeled fire-rated door assemblies except for size.
3. Temperature-Rise Limit: **[Where indicated on Drawings] [At vertical exit enclosures and exit passageways]**, provide doors that have a maximum transmitted temperature end point of not more than **450 deg F** above ambient after 30 minutes of standard fire-test exposure.
 - B. Fire-Rated, Borrowed-Lite Assemblies: Assemblies complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing in accordance with NFPA 257 or UL 9.
 - C. Windborne-Debris Impact Resistance: Passes ASTM E1886 missile-impact and cyclic-pressure tests in accordance with ASTM E1996 for Wind Zone **[1] [2] [3] [4]** for **[basic] [enhanced]** protection.
 1. Large-Missile Test: For glazed openings located within **[30 feet]** **<Insert dimension>** of grade.
 - D. Thermally Rated Door Assemblies: Provide door assemblies with U-factor of not more than **[0.50 deg Btu/F x h x sq. ft.] [0.40 deg Btu/F x h x sq. ft.] [0.38 deg Btu/F x h x sq. ft.]** **<Insert U-factor>** when tested in accordance with ASTM C1363 or ASTM E1423.

2.2 INTERIOR STANDARD STEEL DOORS AND FRAMES

- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Standard-Duty Doors and Frames: ANSI/SDI A250.8, Level 1; ANSI/SDI A250.4, Level C. **[At locations indicated in the Door and Frame Schedule on Drawings]** **<Insert locations>**.
 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **[1-3/4 inches] [1-3/8 inches]**.
 - c. Face: **[Uncoated] [Metallic-coated]** steel sheet, minimum thickness of **0.032 inch**.
 - d. Edge Construction: **[Model 1, Full Flush] [Model 2, Seamless]**.
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] **[Provide manufacturer's standard beveled or square edges]**.
 - f. Core: **[Manufacturer's standard] [Kraft-paper honeycomb] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener]**.
 - g. Fire-Rated Core: Manufacturer's standard **[vertical steel stiffener] [laminated mineral board]** core for fire-rated **[and temperature-rise-rated]** doors.
 2. Frames:
 - a. Materials: **[Uncoated] [Metallic-coated]** steel sheet, minimum thickness of **0.042 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: **[Knocked down] [Slip-on drywall] [Face welded] [Full profile welded]**.
 3. Exposed Finish: **[Prime] [Factory]**.
- C. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. **[At**

locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.

1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.042 inch**.
 - d. Edge Construction: [Model 1, Full Flush] [Model 2, Seamless].
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] [Provide manufacturer's standard beveled or square edges].
 - f. Core: [Manufacturer's standard] [Kraft-paper honeycomb] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener].
 - g. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener] [laminated mineral board] core for fire-rated [and temperature-rise-rated] doors.
 2. Frames:
 - a. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.053 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: [Knocked down] [Slip-on drywall] [Face welded] [Full profile welded].
 3. Exposed Finish: [Prime] [Factory].
- D. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.053 inch**.
 - d. Edge Construction: [Model 1, Full Flush] [Model 2, Seamless] [Model 3, Stile and Rail].
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] [Provide manufacturer's standard beveled or square edges].
 - f. Core: [Manufacturer's standard] [Kraft-paper honeycomb] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener].
 - g. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener] [laminated mineral board] core for fire-rated [and temperature-rise-rated] doors.
 2. Frames:
 - a. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.053 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: [Knocked down] [Slip-on drywall] [Face welded] [Full profile welded].
 3. Exposed Finish: [Prime] [Factory].
- E. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.

1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.067 inch**.
 - d. Edge Construction: [Model 1, Full Flush] [Model 2, Seamless].
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] [Provide manufacturer's standard beveled or square edges].
 - f. Core: [Manufacturer's standard] [Kraft-paper honeycomb] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener].
 - g. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener] [laminated mineral board] core for fire-rated [and temperature-rise-rated] doors.
 2. Frames:
 - a. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.067 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: [Knocked down] [Slip-on drywall] [Face welded] [Full profile welded].
 3. Exposed Finish: [Prime] [Factory].
- 2.3 EXTERIOR STANDARD STEEL DOORS AND FRAMES
- A. Construct hollow-metal doors and frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
 - B. Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 2; ANSI/SDI A250.4, Level B. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.042 inch**, with minimum [A40] [A60] coating.
 - d. Edge Construction: [Model 1, Full Flush] [Model 2, Seamless].
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] [Provide manufacturer's standard beveled or square edges].
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors [where required for attachment of weather stripping] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: [Manufacturer's standard] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener].
 - i. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener with insulation] [laminated mineral board] core for fire-rated doors.
 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with

- minimum [A40] [A60] coating.
 - b. Construction: [Knocked down] [Face welded] [Full profile welded].
 - 3. Exposed Finish: [Prime] [Factory].
- C. Extra-Heavy-Duty Doors and Frames: ANSI/SDI A250.8, Level 3; ANSI/SDI A250.4, Level A. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with minimum [A40] [A60] coating.
 - d. Edge Construction: [Model 1, Full Flush] [Model 2, Seamless] [Model 3, Stile and Rail].
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] [Provide manufacturer's standard beveled or square edges].
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors[**where required for attachment of weather stripping**] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - h. Core: [Manufacturer's standard] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener].
 - i. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener with insulation] [laminated mineral board] core for fire-rated doors.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with minimum [A40] [A60] coating.
 - b. Construction: [Knocked down] [Face welded] [Full profile welded].
 - 3. Exposed Finish: [Prime] [Factory].
- D. Maximum-Duty Doors and Frames: ANSI/SDI A250.8, Level 4; ANSI/SDI A250.4, Level A. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.067 inch**, with minimum [A40] [A60] coating.
 - d. Edge Construction: [Model 1, Full Flush] [Model 2, Seamless].
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**] [Provide manufacturer's standard beveled or square edges].
 - f. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - g. Bottom Edges: Close bottom edges of doors[**where required for attachment of weather stripping**] with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to

- escape.
 - h. Core: [Manufacturer's standard] [Polystyrene] [Polyurethane] [Polyisocyanurate] [Vertical steel stiffener].
 - i. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener with insulation] [laminated mineral board] core for fire-rated doors.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.067 inch**, with minimum [A40] [A60] coating.
 - b. Construction: [Knocked down] [Face welded] [Full profile welded].
 - 3. Exposed Finish: [Prime] [Factory].
- 2.4 INTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES
- A. Hollow-Metal Doors and Frames: NAAMM-HMMA 860; ANSI/SDI A250.4, Physical Performance Level A. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of [**0.032 inch**] [**0.042 inch**] [**0.053 inch**].
 - d. Edge Construction: [Continuously welded with no] [Projection or tack welded with no] [Interlocking with] [Projection or tack welded with] visible seam.
 - e. Core: Steel stiffened.
 - f. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener] [laminated mineral board] core for fire-rated [and temperature-rise-rated] doors.
 - 2. Frames:
 - a. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.053 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: [Knocked down] [Slip-on drywall] [Face welded] [Full profile welded].
 - 3. Exposed Finish: Prime.
 - B. Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.042 inch**.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Core: Steel stiffened.
 - f. Fire-Rated Core: Manufacturer's standard [vertical steel stiffener] [laminated mineral board] core for fire-rated [and temperature-rise-rated] doors.
 - 2. Frames:
 - a. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of **0.053 inch**, except **0.067 inch** for openings exceeding **4 feet** wide.
 - b. Sidelite and Transom Frames: Fabricated from same material as adjacent door

- frame.
- c. Construction: **[Face] [Full profile]** welded.
- 3. Exposed Finish: Prime.
- C. Commercial Laminated Doors and Frames: NAAMM-HMMA 867; ANSI/SDI A250.4, Physical Performance Level A. **[At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>**.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: **[Uncoated] [Metallic-coated]** steel sheet, minimum thickness of **[0.032 inch] [0.042 inch] [0.053 inch]**.
 - d. Edge Construction: **[Continuously welded with no visible seam] [Interlocking with visible seam] [Interlocking with no visible seam] [Projection, spot, or tack welded with or without visible seams]**.
 - e. Edge Bevel: [Bevel lock and hinge edges **1/8 inch in 2 inches**] [Bevel lock edge **1/8 inch in 2 inches**].
 - f. Core: **[Kraft-paper honeycomb] [Polyisocyanurate] [Polystyrene] [Polyurethane] [Vertical steel stiffener]**.
 - g. Fire-Rated Core: Manufacturer's standard **[vertical steel stiffener] [laminated mineral board]** core for fire-rated **[and temperature-rise-rated]** doors.
 - 2. Frames:
 - a. Materials: **[Uncoated] [Metallic-coated]** steel sheet, minimum thickness of **0.053 inch**.
 - b. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - c. Construction: **[Knocked down] [Slip-on drywall] [Face welded] [Full profile welded]**.
 - 3. Exposed Finish: **[Prime] [Unprimed]**.
- 2.5 EXTERIOR CUSTOM HOLLOW-METAL DOORS AND FRAMES
 - A. Commercial Doors and Frames: NAAMM-HMMA 861; ANSI/SDI A250.4, Physical Performance Level A. **[At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>**.
 - 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with minimum **G60 or A60** coating.
 - d. Edge Construction: Continuously welded with no visible seam.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors **[where required for attachment of weather stripping]** with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: Steel stiffened.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, except

- 0.067 inch** for openings exceeding **4 feet** wide; with minimum **G60 or A60** coating.
- b. Construction: **[Face]** **[Full profile]** welded.
 - 3. Exposed Finish: Prime.
- B. Commercial Laminated Doors and Frames: NAAMM-HMMA 867; ANSI/SDI A250.4, Physical Performance Level A. **[At locations indicated in the Door and Frame Schedule on Drawings]** **<Insert locations>**.
- 1. Doors:
 - a. Type: As indicated in the Door and Frame Schedule on Drawings.
 - b. Thickness: **1-3/4 inches**.
 - c. Face: Metallic-coated steel sheet, minimum thickness of **[0.053 inch]** **[0.042 inch]**, with minimum **G60 or A60** coating.
 - d. Edge Construction: **[Continuously welded with no visible seam]** **[Interlocking with visible seam]** **[Interlocking with no visible seam]** **[Projection, spot, or tack welded with or without visible seams]**.
 - e. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets. Seal joints against water penetration.
 - f. Bottom Edges: Close bottom edges of doors **[where required for attachment of weather stripping]** with end closures or channels of same material as face sheets. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
 - g. Core: **[Kraft-paper honeycomb]** **[Polyisocyanurate]** **[Polystyrene]** **[Polyurethane]** **[Vertical steel stiffener]**.
 - 2. Frames:
 - a. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch**, with minimum **G60 or A60** coating.
 - b. Construction: **[Knocked down]** **[Face welded]** **[Full profile welded]**.
 - 3. Exposed Finish: **[Prime]** **[Unprimed]**.
- 2.6 BORROWED LITES
- A. Fabricate of **[uncoated]** **[metallic-coated]** steel sheet, minimum thickness of **[0.053 inch]** **[0.042 inch]**.
 - B. Construction: **[Knocked down]** **[Face welded]** **[Full profile welded]**.
 - C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
 - D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
- 2.7 HOLLOW-METAL PANELS
- A. Provide hollow-metal panels of same materials, construction, and finish as adjacent door assemblies.
- 2.8 FRAME ANCHORS
- A. Jamb Anchors:

1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each **24 inches** of frame height above **7 feet**.
 3. Postinstalled Expansion Anchor: Minimum **3/8-inch**- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than **2-inch** height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), **04Z** coating designation; mill phosphatized.
1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.

2.9 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25]** **<Insert value>** percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- H. Glazing: Comply with requirements in Section 088000 "Glazing."

2.10 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum **3/4 inch** beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.

- B. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding[, or by rigid mechanical anchors].
 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 4. Terminated Stops (Hospital Stops): Terminate stops [6 inches] <Insert dimension> above finish floor with a [45] [90]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- C. Hardware Preparation: Factory prepare hollow-metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
 2. Comply with BHMA A156.115 for preparing hollow-metal doors and frames for hardware.
- D. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with [butted] [or] [mitered] hairline joints.
1. Provide stops and moldings flush with face of door, and with [beveled] [square] stops unless otherwise indicated.
 2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames. Provide loose stops and moldings on inside of hollow-metal doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 5. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.
- 2.11 STEEL FINISHES
- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's

sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

2.12 LOUVERS

- A. Provide louvers for interior doors, where indicated, which comply with SDI 111, with blades or baffles formed of **0.020-inch-** thick, cold-rolled steel sheet set into **0.032-inch-** thick steel frame.
 - 1. Sightproof Louver: Stationary louvers constructed with inverted-V or inverted-Y blades.
 - 2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other.
 - 3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door assemblies of type and fire-resistance rating indicated by same qualified testing and inspecting agency that established fire-resistance rating of door assembly.
- B. Form corners of moldings with hairline joints. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. Install hollow-metal doors and frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions.
- B. Hollow-Metal Frames: Comply with [ANSI/SDI A250.11] [NAAMM-HMMA 840].
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 - a. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 - b. Install frames with removable stops located on secure side of opening.
 - 2. Fire-Rated Openings: Install frames in accordance with NFPA 80.
 - 3. Floor Anchors: Secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 4. Solidly pack mineral-fiber insulation inside frames.
 - 5. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
 - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. [**Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.**]
 - 7. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:

- a. Squareness: Plus or minus **1/16 inch**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus **1/16 inch**, measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus **1/16 inch**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus **1/16 inch**, measured at jambs at floor.
- C. Hollow-Metal Doors: Fit and adjust hollow-metal doors accurately in frames, within clearances specified below.
- 1. Non-Fire-Rated Steel Doors: Comply with [ANSI/SDI A250.8] [NAAMM-HMMA 841 and NAAMM-HMMA guide specification indicated].
 - 2. Fire-Rated Doors: Install doors with clearances in accordance with NFPA 80.
 - 3. Smoke-Control Doors: Install doors in accordance with NFPA 105.
- D. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

3.3 FIELD QUALITY CONTROL

- A. Inspection Agency: [Owner will engage] [Engage] a qualified inspector to perform inspections and to furnish reports to Architect.
- B. Inspections:
- 1. Fire-Rated Door Inspections: Inspect each fire-rated door in accordance with NFPA 80, Section 5.2.
 - 2. Egress Door Inspections: Inspect each door equipped with panic hardware, each door equipped with fire exit hardware, each door located in an exit enclosure, each electrically controlled egress door, and each door equipped with special locking arrangements in accordance with NFPA 101, Section 7.2.1.15.
- C. Repair or remove and replace installations where inspections indicate that they do not comply with specified requirements.
- D. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- E. Prepare and submit separate inspection report for each fire-rated door assembly indicating compliance with each item listed in [NFPA 80] [and] [NFPA 101].

3.4 REPAIR

- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.
- C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.
- D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in

painting Sections.

END OF SECTION 081113

SECTION 081213 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior standard steel frames.
 - 2. Exterior standard steel frames.
 - 3. Interior custom hollow-metal frames.
 - 4. Exterior custom hollow-metal frames.
 - 5. Borrowed lites.
- B. Related Requirements:
 - 1. Section 081113 "Hollow Metal Doors and Frames" for hollow-metal doors and frames.
 - 2. Section 081119 "Stainless Steel Doors and Frames" for hollow-metal doors and frames manufactured from stainless steel.
 - 3. **[Section 087100 "Door Hardware"] [Section 087111 "Door Hardware (Descriptive Specification)"]** for door hardware for hollow-metal doors.

1.2 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

1.3 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Interior standard steel frames.
 - 2. Exterior standard steel frames.
 - 3. Interior custom hollow-metal frames.
 - 4. Exterior custom hollow-metal frames.
 - 5. Borrowed lites.
- B. Product Data Submittals: For each product.
 - 1. Include construction details, material descriptions, **[fire-resistance ratings,]** and finishes.
- C. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Environmental Product Declaration: For each product.
 - 3. Health Product Declaration: For each product.

4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 5. Environmental Product Declaration: For each product.
 6. Environmental Product Declaration: For each product.
 7. Environmental Product Declaration: For each product.
 8. Third-Party Certifications: For each product.
 9. Third-Party Certified Life Cycle Assessment: For each product.
- D. Shop Drawings: Include the following:
1. Elevations of each frame type.
 2. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
 3. Locations of reinforcement and preparations for hardware.
 4. Details of each different wall opening condition.
 5. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 6. Details of anchorages, joints, field splices, and connections.
 7. Details of accessories.
 8. Details of moldings, removable stops, and glazing.
- E. Samples for Initial Selection: For hollow-metal frames with factory-applied color finishes.
- F. Samples for Verification:
1. Finishes: For each type of exposed finish required, prepared on Samples of not less than **3 by 5 inches**.
 2. Fabrication: Prepare Samples approximately [**12 by 12 inches**] [**8 by 10 inches**] <Insert **dimension**> to demonstrate compliance with requirements for quality of materials and construction. Show profile, corner joint, floor and wall anchors, and silencers.
- G. Product Schedule: For hollow-metal frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.
- 1.6 INFORMATIONAL SUBMITTALS
- A. Product Test Reports: For each type of [**fire-rated hollow-metal frame assembly**] [**and**] [**fire-rated borrowed-lite assembly**] for tests performed by a qualified testing agency indicating compliance with performance requirements.
- B. Oversize Construction Certification: For assemblies required to be fire-rated and exceeding limitations of labeled assemblies.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver hollow-metal frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
1. Provide additional protection to prevent damage to factory-finished units.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow-metal frames vertically under cover at Project site with head up. Place on minimum **4-inch**- high wood blocking. Provide minimum **1/4-inch** space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated on Drawings, based on testing at positive pressure according to NFPA 252 or UL 10C.
 - 1. Smoke- and Draft-Control Assemblies: Listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.
 - 2. Oversize Fire-Rated Frames: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that frames comply with standard construction requirements for tested and labeled fire-rated assemblies except for size.
- B. Fire-Rated, Borrowed-Lite Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

2.2 STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Interior Standard Steel Frames: SDI A250.8. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of [0.042 inch] [0.053 inch] [0.067 inch].
 - 2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - 3. Construction: [Knocked down] [Slip-on drywall] [Face welded] [Full profile welded].
 - 4. Exposed Finish: [Prime] [Factory].
- C. Exterior Standard Steel Frames: SDI A250.8. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Materials: Metallic-coated steel sheet, minimum thickness of [0.053 inch] [0.067 inch], with minimum [A40] [A60] coating.
 - 2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - 3. Construction: [Knocked down] [Face welded] [Full profile welded].
 - 4. Exposed Finish: [Prime] [Factory].

2.3 CUSTOM HOLLOW-METAL FRAMES

- A. Interior Custom Hollow-Metal Frames: NAAMM-HMMA 861. [At locations indicated in the Door and Frame Schedule on Drawings] <Insert locations>.
 - 1. Materials: [Uncoated] [Metallic-coated] steel sheet, minimum thickness of 0.053 inch.
 - 2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
 - 3. Construction: [Knocked down] [Slip-on drywall] [Face welded] [Full profile welded].
 - 4. Exposed Finish: Prime.
- B. Exterior Custom Hollow-Metal Frames: NAAMM-HMMA 861. [At locations indicated in the

Door and Frame Schedule on Drawings] <Insert locations>.

1. Materials: Metallic-coated steel sheet, minimum thickness of **0.053 inch**.
2. Sidelite and Transom Frames: Fabricated from same thickness material as adjacent door frame.
3. Construction: [**Knocked down**] [**Face welded**] [**Full profile welded**].
4. Exposed Finish: Prime.

2.4 BORROWED LITES

- A. Fabricate of [**uncoated**] [**metallic-coated**] steel sheet, minimum thickness of [**0.053 inch**] [**0.042 inch**].
- B. Construction: [**Knocked down**] [**Face welded**] [**Full profile welded**].
- C. Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as metal as frames.
- D. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

2.5 FRAME ANCHORS

- A. Jamb Anchors:
 1. Type: Anchors of minimum size and type required by applicable door and frame standard, and suitable for performance level indicated.
 2. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each **24 inches** of frame height above **7 feet**.
 3. Postinstalled Expansion Anchor: Minimum **3/8-inch**- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
- B. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
- C. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips, allowing not less than **2-inch** height adjustment. Terminate bottom of frames at top of underlayment.
- D. Material: ASTM A879/A879M, Commercial Steel (CS), **04Z** coating designation; mill phosphatized.
 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized according to ASTM A153/A153M, Class B.

2.6 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [**25**] **<Insert value>** percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153/A153M.
- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- G. Glazing: Comply with requirements in Section 088000 "Glazing."

2.7 FABRICATION

- A. Hollow-Metal Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of metal of same or greater thickness as frames.
 - 1. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by welding[, or by rigid mechanical anchors].
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
 - 4. Terminated Stops: Terminate stops [6 inches] <Insert dimension> above finish floor with a [45] [90]-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.
- B. Hardware Preparation: Factory prepare hollow-metal frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule on Drawings, and templates.
 - 1. Reinforce frames to receive nontemplated, mortised, and surface-mounted door hardware.
 - 2. Comply with BHMA A156.115 for preparing hollow-metal frames for hardware.
- C. Glazed Lites: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with [butted] [or] [mitered] hairline joints.
 - 1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 2. Provide fixed frame moldings on outside of exterior and on secure side of interior frames. Provide loose stops and moldings on inside of hollow-metal frames.
 - 3. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
 - 4. Provide stops for installation with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

2.8 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with SDI A250.3.
 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.**

PART 3 - EXECUTION

3.1 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.2 INSTALLATION

- A. General: Install hollow-metal frames plumb, rigid, properly aligned, and securely fastened in place. Comply with approved Shop Drawings and with manufacturer's written instructions. Comply with **[SDI A250.11] [NAAMM-HMMA 840]**.
- B. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces without damage to completed Work.
 1. Where frames are fabricated in sections, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces. Touch-up finishes.
 2. Install frames with removable stops located on secure side of opening.
- C. Fire-Rated Openings: Install frames according to NFPA 80.
- D. Floor Anchors: Secure with postinstalled expansion anchors.
 1. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
- E. Solidly pack mineral-fiber insulation inside frames.
- F. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout or mortar.
- G. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. **[Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.]**
- H. Installation Tolerances: Adjust hollow-metal frames to the following tolerances:
 1. Squareness: Plus or minus **1/16 inch**, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 2. Alignment: Plus or minus **1/16 inch**, measured at jambs on a horizontal line parallel to

- plane of wall.
3. Twist: Plus or minus **1/16 inch**, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 4. Plumbness: Plus or minus **1/16 inch**, measured at jambs at floor.
- I. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.
- 3.3 **CLEANING AND TOUCHUP**
- A. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
 - B. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
 - C. Factory-Finish Touchup: Clean abraded areas and repair with same material used for factory finish according to manufacturer's written instructions.
 - D. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081213

SECTION 081216 - ALUMINUM FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data:

1. Interior aluminum doors, door frames, and glazing frames.

- B. Product Data Submittals: For each product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, **[fire-resistance rating]**, and finishes.

- C. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

- D. Shop Drawings: For aluminum frames:

1. Include elevations, sections, and installation details for each wall-opening condition.
2. Include details for each frame type, including dimensioned profiles and metal thicknesses.
3. Include locations of reinforcements and preparations for hardware.
4. Include details of anchorages, joints, field splices, connections, and accessories.
5. Include details of moldings, removable stops, and glazing.

- E. Samples: For each exposed product and for each color and texture specified, **[in manufacturer's standard sizes]** **[6 inches square in size]** <Insert dimensions>.

- F. Samples for Initial Selection: For each type of exposed finish.

1. Include Samples of seals, gaskets, and accessories involving color selection.

- G. Samples for Verification: For each type of the following products:

1. Framing Member and Finish: **12 inches** long. Include trim.
2. Corner Fabrication and Finish: **12-by-12-inch-** long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.
3. Door Finish: Manufacturer's standard-size unit, but not less than **[3 inches square]** <Insert dimensions>.

- H. Product Schedule: For aluminum frames. **[Use same designations indicated on Drawings.]**
Coordinate with door hardware schedule and glazing.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For aluminum frames to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for fabrication and installation.
 - 1. Build mockup of each type of aluminum frame[**and door**] in typical wall area as shown on Drawings.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Frames: Frames for fire-rated door assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to [**NFPA 252**] [**or**] [**UL 10C**].
 - 1. Oversize Fire-Rated Frames: For units exceeding sizes of tested assemblies, provide certification by a qualified testing agency that frames comply with standard construction requirements for tested and labeled fire-rated frames except for size.
 - 2. Frames for Smoke- and Draft-Control Assemblies: Tested according to UL 1784 and installed in compliance with NFPA 105.
 - a. Air Leakage Rate: Maximum air leakage of **0.3 cfm/sq. ft.** at the tested pressure differential of **0.3-inch wg.**

2.2 ACCESSORIES

- A. Fasteners: Aluminum, nonmagnetic, stainless steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.
- B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals in [**black**] **<Insert color>** color.
- C. Smoke Seals: Intumescent strip or fire-rated gaskets in [**black**] **<Insert color>**.
- D. Glazing Gaskets: Manufacturer's standard extruded or molded rubber or plastic, to accommodate glazing thickness indicated; in [**black**] **<Insert color>**.
- E. Glass: As specified in [**Section 088000 "Glazing."**] [**Section 088113 "Decorative Glass Glazing."**] [**Section 088400 "Plastic Glazing."**]
- F. Door Hardware: [**As selected by Architect from manufacturer's full range.**] [**As specified in Section 087100 "Door Hardware."**] [**As specified in Section 087111 "Door Hardware (Descriptive Specification)."**] **<Insert requirement.>**

2.3 FABRICATION

- A. Provide concealed corner reinforcements and alignment clips for accurately fitted hairline joints at butted and mitered connections.
- B. Factory prepare aluminum frames to receive templated mortised hardware; include cutouts,

reinforcements, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in [Section 087100 "Door Hardware."] [Section 087111 "Door Hardware (Descriptive Specification).]

1. Locate hardware cutouts and reinforcements as required by fire-rated label for assembly.
- C. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.
 1. Locate removable stops on the inside of spaces accessed by keyed doors.
- D. Fabricate components to allow secure installation without exposed fasteners.

2.4 GENERAL FINISH REQUIREMENTS

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- B. Color Anodic Finish: AAMA 611, AA-M12C22A32/A34, Class II, 0.010 mm or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
- D. High-Performance Organic Finish: Two-coat fluoropolymer finish complying with AAMA 2604 and containing not less than [50] [70] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that wall thickness does not exceed standard tolerances allowed by throat size of indicated aluminum frame.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install aluminum frames plumb, rigid, properly aligned, and securely fastened in place; according to manufacturer's written instructions.
 1. At fire-protection-rated openings, install fire-rated frames according to NFPA 80[and NFPA 105].
- B. Install frame components in the longest possible lengths with no piece less than **48 inches**; components [72 inches] [96 inches] <Insert dimension> or shorter must be one piece.
 1. Fasten to suspended ceiling grid on maximum [48-inch] <Insert number> centers, using

- sheet metal screws or other fasteners approved by frame manufacturer.
 - 2. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
 - 3. Secure clips to extruded main-frame components and not to snap-in or trim members.
 - 4. Do not leave screws or other fasteners exposed to view when installation is complete.
 - C. Glass: Install glass according to [**Section 088000 "Glazing" and**] [**Section 088113 "Decorative Glass Glazing" and**] [**Section 088400 "Plastic Glazing" and**] aluminum-frame manufacturer's written instructions.
 - D. Doors: Install doors aligned with frames and fitted with required hardware.
 - E. Door Hardware: Install according to [**Section 087100 "Door Hardware" and**] [**Section 087111 "Door Hardware (Descriptive Specification)" and**] aluminum-frame manufacturer's written instructions.
- 3.3 ADJUSTING
- A. Inspect installation, correct misalignments, and tighten loose connections.
 - B. Doors: Adjust doors to operate smoothly and easily, without binding or warping. Adjust hardware to function smoothly, and lubricate as recommended by manufacturer.
 - C. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended in writing by frame manufacturer and according to AAMA 609 and AAMA 610.
 - D. Touch Up: Repair marred frame surfaces to blend inconspicuously with adjacent unrepaired surface[so touchup is not visible from a distance of **48 inches**] as viewed by Architect. Remove and replace frames with damaged finish that cannot be satisfactorily repaired.

END OF SECTION 081216

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical door hardware for the following:
2. Mechanical door hardware for the following:
 - a. Swinging doors.
 - b. Sliding doors.
 - c. Folding doors.
3. Cylinders for door hardware specified in other Sections.
4. Electrified door hardware.

B. Related Requirements:

1. **[Section 064113 "Wood-Veneer-Faced Architectural Cabinets"] [and] [Section 064116 "Plastic-Laminate-Clad Architectural Cabinets"]** for cabinet door hardware provided with cabinets.
2. Section 081113 "Hollow Metal Doors and Frames" **[for astragals provided as part of labeled fire-rated assemblies] [and] [for door silencers provided as part of hollow-metal frames]**.
3. Section 081119 "Stainless-Steel Doors and Frames" **[for astragals provided as part of labeled fire-rated assemblies] [and] [for door silencers provided as part of stainless steel frames]**.
4. Section 081173 "Sliding Metal Fire Doors" for door and track preparation, reinforcement, and motorized operators provided as part of automatic-closing assemblies.
5. Section 081213 "Hollow Metal Frames" **[for astragals provided as part of labeled fire-rated assemblies] [and] [for door silencers provided as part of hollow-metal frames]**.
6. Section 081216 "Aluminum Frames" for door silencers provided as part of aluminum frames.
7. Section 081316.13 "Aluminum Terrace Doors" for entrance door hardware, **[except] [including]** cylinders.
8. Section 081416 "Flush Wood Doors" for **[astragals] [and] [integral intumescent seals]** provided as part of labeled fire-rated assemblies.
9. Section 081433 "Stile and Rail Wood Doors" for **[astragals] [and] [integral intumescent seals]** provided as part of labeled fire-rated assemblies.
10. Section 083113 "Access Doors and Frames" for access door hardware, **[except] [including]** cylinders.
11. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead coiling door assemblies.
12. Section 083326 "Overhead Coiling Grilles" for door hardware provided as part of overhead coiling grille assemblies.
13. **[Section 083473.13 "Metal Sound Control Door Assemblies"] [and] [Section 083473.16 "Wood Sound Control Door Assemblies"]** for hinges and gasketing provided as part of sound-rated door assemblies.
14. Section 083513 "Folding Doors" for pulls, latches, hinges, guides, and pivots provided as part of the folding door package.
15. Section 084113 "Aluminum-Framed Entrances and Storefronts" for entrance door hardware, **[except] [including]** cylinders.

16. Section 084126 "All-Glass Entrances and Storefronts" for entrance door hardware, **[except] [including]** cylinders.
17. Section 084229.13 "Folding Automatic Entrances" for entrance door hardware, **[except] [including]** cylinders.
18. Section 084229.23 "Sliding Automatic Entrances" for entrance door hardware, **[except] [including]** cylinders.
19. Section 084229.33 "Swinging Automatic Entrances" for entrance door hardware, **[except] [including]** cylinders.
20. Section 084243 "Intensive Care Unit/Critical Care Unit (ICU/CCU) Entrances" for entrance door hardware, **[except] [including]** cylinders.
21. Section 087113 "Power Door Operators" for low-energy power operators and low-energy power-assist operators.
22. Section 102213 "Wire Mesh Partitions" for door hardware for doors in wire mesh partitions, **[except] [including]** cylinders.
23. Section 102600 "Wall and Door Protection" for plastic door protection units that match wall protection units.
24. Section 119812 "Detention Doors and Frames" for door silencers provided as part of detention frames.
25. Section 119814 "Detention Door Hardware" for hardware for detention doors.
26. Section 133419 "Metal Building Systems" for door hardware, **[except] [including]** cylinders.
27. Section 134900 "Radiation Protection" for lead-lined astragals provided as part of labeled fire-rated assemblies.
28. Section 283100 "Intrusion Detection" for detection devices installed at door openings and provided as part of an intrusion-detection system.
29. Section 284621.11 "Addressable Fire-Alarm Systems" for connections to building fire-alarm system.
30. Section 284621.13 "Conventional Fire-Alarm Systems" for connections to building fire-alarm system.

1.2 ALLOWANCES

- A. Door hardware is part of **[Door Hardware Allowance]** <Insert allowance>.

1.3 COORDINATION

- A. Floor-Recessed Door Hardware: Coordinate layout and installation with floor construction.
 1. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.
- E. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field verify existing conditions and coordinate installation of door hardware to suit opening conditions and to

provide proper door operation.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** **<Insert location>**.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant[**and Owner's security consultant**].
- B. Keying Conference: Conduct conference at **[Project site]** **<Insert location>**.
 - 1. Conference participants shall include Installer's Architectural Hardware Consultant[**and Owner's security consultant**].
 - 2. Incorporate conference decisions into keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - a. Flow of traffic and degree of security required.
 - b. Preliminary key system schematic diagram.
 - c. Requirements for key control system.
 - d. Requirements for access control.
 - e. Address for delivery of keys.
 - f. **<Insert requirements to suit Project>**.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For electrified door hardware.
 - 1. Include diagrams for power, signal, and control wiring.
 - 2. Include details of interface of electrified door hardware and building safety and security systems.
- C. Samples: For each exposed product in each finish specified, in manufacturer's standard size.
 - 1. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- D. Samples for Initial Selection: For each type of exposed finish.
- E. Samples for Verification: For each type of exposed product, in each finish specified.
 - 1. Sample Size: Full-size units or minimum **2-by-4-inch** Samples for sheet and **4-inch** long Samples for other products.
 - a. Full-size Samples will be returned to Contractor. Units that are acceptable and remain undamaged through submittal, review, and field comparison process may, after final check of operation, be incorporated into the Work, within limitations of keying requirements.
 - 2. Tag Samples with full product description to coordinate Samples with door hardware schedule.
- F. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule **[after]** **[or]** **[concurrent with]**

- submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
2. Format: Use same scheduling sequence and format[**and use same door numbers**] as in door hardware schedule in the Contract Documents.
 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Description of electrified door hardware sequences of operation and interfaces with other building control systems.
 - e. Fastenings and other installation information.
 - f. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - g. Mounting locations for door hardware.
 - h. List of related door devices specified in other Sections for each door and frame.
- G. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [**Installer**] [**and**] [**Architectural Hardware Consultant**].
- B. Product Certificates: For each type of electrified door hardware.
 1. Certify that door hardware for use on each type and size of labeled fire-rated doors complies with listed fire-rated door assemblies.
- C. Product Test Reports: For compliance with accessibility requirements, for tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.
- D. Field quality-control reports.
- E. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final [**door hardware**] [**and**] [**keying**] schedule.

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. Door Hardware: <**Insert detailed descriptions and specific numbers of units**>.
 2. Electrical Parts: <**Insert detailed descriptions and specific numbers of units**>.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
 - 3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an **[Architectural Hardware Consultant (AHC)] [Architectural Hardware Consultant (AHC) and an Electrified Hardware Consultant (EHC)] [Architectural Openings Consultant (AOC)]**.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.
- D. Deliver keys[**and permanent cores**] to Owner by registered mail or overnight package service.

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
 - 2. Warranty Period: **[Three]** **<Insert number>** years from date of Substantial Completion unless otherwise indicated below:
 - a. **[Electromagnetic]** **[and]** **[Delayed-Egress]** Locks: **[Five]** **<Insert number>** years from date of Substantial Completion.
 - b. Exit Devices: **[Two]** **<Insert number>** years from date of Substantial Completion.
 - c. Manual Closers: **[10]** **<Insert number>** years from date of Substantial Completion.
 - d. Concealed Floor Closers: **[Five]** **[10]** **[25]** **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations: Obtain each type of door hardware from single manufacturer.
 - 1. Provide electrified door hardware from same manufacturer as mechanical door hardware unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that complies with requirements of assemblies tested in accordance with UL 1784 and installed in compliance with NFPA 105.
 - 1. Air Leakage Rate: Maximum air leakage of [**0.3 cfm/sq. ft.**] <Insert rate> at the tested pressure differential of [**0.3-inch wg**] <Insert value> of water.
- C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Means of Egress Doors: Latches do not require more than **15 lbf** to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with [the USDOJ's "2010 ADA Standards for Accessible Design"] [the DOT's "ADA Standards for Transportation Facilities"] [the ABA standards of the Federal agency having jurisdiction] [ICC A117.1] [HUD's "Fair Housing Accessibility Guidelines"] [and] <Insert regulation>.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than **5 lbf**.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: **5 lbf** applied perpendicular to door.
 - b. Sliding or Folding Doors: **5 lbf** applied parallel to door at latch.
 - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than **1/2 inch** high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.
 - 5. Adjust spring hinges so that, from an open position of 70 degrees, the door will take at least 1.5 seconds to move to the closed position.

2.3 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, appendix. Provide one extra key blank for each lock. [**Incorporate decisions made in keying conference.**]
 - 1. No Master Key System: Only change keys operate cylinders.

- a. Provide three cylinder change keys.
 2. Master Key System: Change keys and a master key operate cylinders.
 - a. Provide three cylinder change keys and five master keys.
 3. Grand Master Key System: Change keys, a master key, and a grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master and grand master keys.
 4. Great-Grand Master Key System: Change keys, a master key, a grand master key, and a great-grand master key operate cylinders.
 - a. Provide three cylinder change keys and five each of master, grand master, and great-grand master keys.
 5. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
 - b. Re-key Owner's existing master key system into new keying system.
 6. Keyed Alike: Key all cylinders to same change key.
- B. Keys: **[Nickel silver] [Brass]**.
1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: **["DO NOT DUPLICATE."] [Information to be furnished by Owner.]**
- 2.4 ACCESSORIES FOR PAIRS OF DOORS
- A. Coordinators: BHMA A156.3; consisting of active-leaf, hold-open lever and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release[; **and with internal override**].
 - B. Carry-Open Bars: BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
 - C. Astragals: BHMA A156.22.
- 2.5 FABRICATION
- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rating labels and as otherwise approved by Architect.
 1. Manufacturer's identification is permitted on rim of lock cylinders only.
 - B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
 - C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for

installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

2. Fire-Rated Applications:
 - a. Wood or Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames[; **use threaded-to-the-head wood screws for wood doors and frames**].
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.6 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights [**indicated on Drawings**] [**to comply with the following**] unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 2. Custom Steel Doors and Frames: HMMA 831.
 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every **30 inches** of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every **30 inches** of door height greater than **90 inches**.
- E. Lock Cylinders: Install construction cores to secure building and areas during construction period.
1. Replace construction cores with permanent cores as **[indicated in keying schedule]** **[directed by Owner]**.
 2. Furnish permanent cores to Owner for installation.
- F. Key Control System:
1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
 2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.
 3. Key Control System Software: Set up multiple-index system based on final keying schedule.
- G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, **[above accessible ceilings]** **[in equipment room]**. Verify location with Architect.
1. Configuration: Provide **[one power supply for each door opening]** **[least number of power supplies required to adequately serve doors]** with electrified door hardware.
- H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."
- I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

- J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
 - 1. Do not notch perimeter gasketing to install other surface-applied hardware.
- K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

- A. Independent Architectural Hardware Consultant: **[Owner will engage] [Engage]** a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.
 - 1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
 - 1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
 - 2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.
 - 3. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
- B. Occupancy Adjustment: Approximately **[three] [six] <Insert number>** months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include **[six] [nine] [12] <Insert number>** months' full maintenance by skilled employees of door hardware Installer. Include quarterly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door and door

hardware operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.8 DEMONSTRATION

- A. **[Engage Installer to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain door hardware.

3.9 DOOR HARDWARE SCHEDULE

- A. Hardware Set 1: Each door to have the following:
 - 1. **<Insert hardware type>.**

END OF SECTION 087100

SECTION 089119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fixed [**extruded-aluminum**] [**and**] [**formed-metal**] louvers.
 - 2. Fixed formed-metal acoustical louvers.
 - 3. Blank-off panels for louvers
- B. Related Requirements:
 - 1. Section 081113 "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
 - 2. Section 081416 "Flush Wood Doors" for louvers in flush wood doors.
 - 3. Section 099113 "Exterior Painting" for field painting exterior louvers.
 - 4. Section 099123 "Interior Painting" for field painting interior louvers.

1.2 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades (i.e., the axis of the blades are horizontal).
- C. Vertical Louver: Louver with vertical blades (i.e., the axis of the blades are vertical).
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Wind-Driven-Rain-Resistant Louver: Louver that provides specified wind-driven-rain performance, as determined by testing in accordance with AMCA 500-L.
- F. Windborne-Debris-Impact-Resistant Louver: Louver that provides specified windborne-debris-impact resistance, as determined by testing in accordance with AMCA 540.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Environmental Product Declaration (EPD): For each product.
 - 4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
 - 5. Environmental Product Declaration: For each product.
 - 6. Product Certificates: For regional materials, indicating location of material manufacturer

- and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
7. Environmental Product Declaration: For each product.
 8. Environmental Product Declaration: For each product.
 9. Third-Party Certifications: For each product.
 10. Third-Party Certified Life Cycle Assessment: For each product.
 11. Environmental Product Declaration: For each product.
 12. Health Product Declaration: For each product.
 13. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 14. Environmental Product Declaration: For each product.
 15. Environmental Product Declaration: For each product.
 16. Environmental Product Declaration: For each product.
 17. Third-Party Certifications: For each product.
 18. Third-Party Certified Life Cycle Assessment: For each product.
- C. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
1. Show weep paths, gaskets, flashings, sealants, and other means of preventing water intrusion.
 2. Show mullion profiles and locations.
- D. Samples: For each type of metal finish required.
- E. Delegated Design Submittal: For louvers indicated to comply with structural[**and seismic**] performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Product Test Reports: Based on evaluation of comprehensive tests performed in accordance with AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.
- B. Windborne-debris-impact-resistance test reports.
- C. Sample Warranties: For manufacturer's special warranties.
- 1.5 QUALITY ASSURANCE
- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."
 3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."
- 1.6 FIELD CONDITIONS
- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
- 1.7 WARRANTY
- A. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of baked

enamel, powder coat, or organic finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Warranty Period: **[Five]** **[10]** **[20]** **<Insert number>** years from date of Substantial Completion.
- B. Special Finish Warranty, Anodized Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of anodized finishes within specified warranty period.
1. Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
 - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
 - c. Cracking, peeling, or chipping.
 2. Warranty Period: **[Five]** **[10]** **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain fixed **[and operable]** louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural **[and seismic]** performance requirements and design criteria indicated.
- B. Structural Performance: Louvers withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures are considered to act normal to the face of the building.
1. Wind Loads:
 - a. Determine loads based on pressures as indicated on Drawings.
 - b. Determine loads based on a uniform pressure of **[20 lbf/sq. ft.]** **[30 lbf/sq. ft.]** **<Insert value>**, acting inward or outward.
 - c. Determine loads based on pressures indicated below:
 - 1) Corner Zone: Within **<Insert distance>** of building corners, uniform pressure of **<Insert design wind pressure>**, acting inward, and **<Insert design wind pressure>**, acting outward.
 - 2) Other Than Corner Zone: Uniform pressure of **<Insert design wind pressure>**, acting inward, and **<Insert design wind pressure>**, acting outward.
- C. Windborne-Debris-Impact Resistance: Louvers located within **30 feet** of grade pass **[basic]** **[enhanced]** protection, when tested in accordance with AMCA 540.

- D. Seismic Performance:
1. As indicated on Drawings.
 2. Louvers, including attachments to other construction, withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7] <Insert requirement>.
 - a. Design earthquake spectral response acceleration, short period (Sds) for Project is <Insert value>.
 - b. Component Importance Factor: [1.5] [1.0].
- E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width in accordance with AMCA 500-L.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change (Range): [120 deg F, ambient; 180 deg F, material surfaces] <Insert temperature range>.
- G. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 LOUVER SCREENS

- A. General: Provide screen at [each exterior louver] [louvers indicated].
1. Screen Location for Fixed Louvers: Interior face.
 2. Screening Type: [Bird screening] [Bird screening, except where insect screening is indicated] [Insect screening].
- B. Secure screen frames to louver frames with [stainless steel machine screws] [machine screws with heads finished to match louver], spaced a maximum of 6 inches from each corner and at 12 inches o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
1. Metal: Same type and form of metal as indicated for louver to which screens are attached.[Reinforce extruded-aluminum screen frames at corners with clips.]
 2. Finish: [Same finish as louver frames to which louver screens are attached] [Mill finish unless otherwise indicated].
 3. Type: [Rewirable frames with a driven spline or insert] [Non-rewirable, U-shaped frames].
- D. Louver Screening for Aluminum Louvers:
1. Bird Screening, Aluminum: 1/2-inch- square mesh, 0.063-inch wire.
 2. Bird Screening, Stainless Steel: 1/2-inch- square mesh, 0.047-inch wire.
 3. Bird Screening, Flattened, Expanded Aluminum: 3/4 by 0.050 inch thick.
 4. Insect Screening, Aluminum: 18-by-16 mesh, 0.012-inch wire.
 5. Insect Screening, Stainless Steel: 18-by-18 mesh, 0.009-inch wire.
- E. Louver Screening for Galvanized-Steel Louvers:
1. Bird Screening, Galvanized Steel: 1/2-inch- square mesh, 0.041-inch wire.
 2. Bird Screening, Stainless Steel: 1/2-inch- square mesh, 0.047-inch wire.
 3. Insect Screening, Galvanized Steel: 18-by-14 mesh, 0.011-inch wire.

4. Insect Screening, Stainless Steel: **18-by-18** mesh, **0.009-inch** wire.
- F. Louver Screening for Stainless Steel Louvers:
 1. Bird Screening, Stainless Steel: **1/2-inch-** square mesh, **0.047-inch** wire.
 2. Insect Screening, Stainless Steel: **18-by-18** mesh, **0.009-inch** wire.
- 2.4 BLANK-OFF PANELS
 - A. Uninsulated Blank-Off Panels: Metal sheet attached to back of louver.
 1. Aluminum sheet for aluminum louvers, not less than **0.050-inch** nominal thickness.
 2. Galvanized-steel sheet for galvanized-steel louvers, not less than [**0.040-inch**] [**0.052-inch**] nominal thickness.
 3. Stainless steel sheet for stainless steel louvers, not less than [**0.038-inch**] [**0.050-inch**] nominal thickness, with grain running in same direction as grain of louver blades.
 4. Panel Finish: [**Same finish applied to louvers**] [**Same finish type applied to louvers, but black color**].
 5. Attach blank-off panels with [**clips**] [**sheet metal screws**] <Insert method>.
 - B. Insulated Blank-Off Panels: Laminated panels consisting of an insulating core surfaced on back and front with metal sheets and attached to back of louver.
 1. Thickness: [**1 inch**] [**2 inches**].
 2. Metal Facing Sheets, Aluminum: Not less than **0.032-inch** nominal thickness.
 3. Metal Facing Sheets, Galvanized Steel: Not less than **0.028-inch** nominal thickness.
 4. Metal Facing Sheets, Stainless Steel: Not less than **0.031-inch** nominal thickness.
 5. Insulating Core: [**Rigid, glass-fiber-board insulation**] [or] [**extruded-polystyrene foam**] <Insert insulation material>.
 6. Edge Treatment: Trim perimeter edges of blank-off panels with louver manufacturer's standard [extruded-aluminum-channel frames, not less than **0.080-inch nominal thickness**] [**channel frames**], with corners mitered and with same finish as panels.
 7. Seal perimeter joints between panel faces and louver frames with gaskets or sealant.
 8. Panel Finish: [**Same finish applied to louvers**] [**Same type of finish applied to louvers, but black color**].
 9. Attach blank-off panels with [**clips**] [**sheet metal screws**] <Insert method>.
- 2.5 MATERIALS
 - A. Aluminum Extrusions: **ASTM B221**, Alloy 6063-T5, T-52, or T6.
 - B. Aluminum Sheet: **ASTM B209**, Alloy 3003 or 5005, with temper as required for forming, or as otherwise recommended by metal producer for required finish.
 - C. Galvanized-Steel Sheet: ASTM A653/A653M, [**G60**] [**G90**] zinc coating, mill phosphatized.
 - D. Stainless Steel Sheet: ASTM A240/A240M, Type 304, [**No. 2B finish**] [**No. 2D finish**] [**No. 4 finish, with grain running parallel to length of blades and frame members**] [**No. 4 finish, with grain running perpendicular to length of blades and frame members**] [**No. 4 finish, with grain running perpendicular to length of blades and parallel to length of frame members**] [**No. 6 finish**].
 - E. Fasteners: Use types and sizes to suit unit installation conditions.
 1. Use [**Phillips flat-head**] [**hex-head or Phillips pan-head**] [**tamper-resistant**] screws for exposed fasteners unless otherwise indicated.

2. For fastening aluminum, use aluminum or 300 series stainless steel fasteners.
 3. For fastening galvanized steel, use hot-dip-galvanized-steel or 300 series stainless steel fasteners.
 4. For fastening stainless steel, use 300 series stainless steel fasteners.
 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- F. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, fabricated from stainless steel components, with allowable load or strength design capacities calculated in accordance with ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing in accordance with ASTM E488/E488M conducted by a qualified testing agency.
- G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- H. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] <Insert value> percent.
- I. Recycled Content of Aluminum Components: Postconsumer recycled content plus one-half of preconsumer recycled content not less than [25] [50] <Insert value> percent.
- J. Regional Materials: Products shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.
- K. Regional Materials: Products shall be manufactured within **500 miles** of Project site.
- L. Regional Materials: Products shall be manufactured within **100 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **100 miles** of Project site.
- M. Indigenous Materials: Products shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- N. Regional Materials: Products shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- 2.6 FABRICATION
- A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.
1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern [**unless horizontal mullions are indicated**] [**where indicated**].

2. Horizontal Mullions: Provide horizontal mullions at joints [**unless continuous vertical assemblies are indicated**] [**where indicated**].
 - C. Maintain equal louver blade spacing[, **including separation between blades and frames at head and sill,**] to produce uniform appearance.
 - D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 1. Frame Type: [**Channel**] [**Exterior flange**] [**Interior flange**] unless otherwise indicated.
 - E. Include supports, anchorages, and accessories required for complete assembly.
 - F. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or **72 inches** o.c., whichever is less.
 1. Fully Recessed Mullions: Where indicated, provide mullions fully recessed behind louver blades. Where length of louver exceeds fabrication and handling limitations, fabricate with close-fitting blade splices designed to permit expansion and contraction.
 2. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades, so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.
 3. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.
 4. Exterior Corners: Prefabricated corner units with mitered [**and welded blades**] [**blades with concealed close-fitting splices**] and with [**fully recessed**] [**semirecessed**] mullions at corners.
 - G. Provide [**subsills made of same material as louvers**] [**or**] [**extended sills**] for recessed louvers.
 - H. Join frame members to each other and to fixed louver blades with fillet welds [**concealed from view**] [, **threaded fasteners, or both, as standard with louver manufacturer**] unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
- 2.7 ALUMINUM FINISHES
- A. Finish louvers after assembly.
 - B. Clear Anodic Finish: AAMA 611, [**AA-M12C22A41, Class I, 0.018 mm**] [**AA-M12C22A31, Class II, 0.010 mm**] or thicker.
 - C. Color Anodic Finish: AAMA 611, [**AA-M12C22A42/A44, Class I, 0.018 mm**] [**AA-M12C22A32/A34, Class II, 0.010 mm**] or thicker.
 1. Color: [**Champagne**] [**Light bronze**] [**Medium bronze**] [**Dark bronze**] [**Black**] [**Match Architect's sample**] [**As selected by Architect from full range of industry colors and color densities**] <Insert color>.

- D. Conversion-Coated Finish: AA-C12C42, nonetched, cleaned with inhibited chemicals, and chemical conversion coated with acid chromate-fluoride-phosphate.
- E. Factory-Primed Finish: AA-C12C42R1x with air-dried primer of not less than **2-mil** dry film thickness.
- F. Baked-Enamel or Powder-Coat Finish: AAMA 2603. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.
 - 1. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.**
- G. High-Performance Organic Finish, Two-Coat PVDF: Fluoropolymer finish complying with **[AAMA 2604] [AAMA 2605]** and containing not less than **[50] [70]** percent PVDF resin by weight in color coat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions **[for seacoast and severe environments]**.
 - 2. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.**
- H. Superior-Performance Organic Finish, Three-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions **[for seacoast and severe environments]**.
 - 2. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.**
- I. Superior-Performance Organic Finish, Four-Coat PVDF: Fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions **[for seacoast and severe environments]**.
 - 2. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.**
- J. Superior-Performance Organic Finish, Single-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.
 - 1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
 - 2. Color and Gloss: **[As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.**
- K. Superior-Performance Organic Finish, Two-Coat FEVE: Fluoropolymer finish complying with AAMA 2605.

1. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions for seacoast and severe environments.
2. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

2.8 GALVANIZED-STEEL SHEET FINISHES

- A. Finish louvers after assembly.
- B. Surface Preparation: Clean surfaces with nonpetroleum solvent, so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair in accordance with ASTM A780/A780M.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of **2 mils**.
 1. Color and Gloss: [As indicated by manufacturer's designations] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color and gloss>.

2.9 STAINLESS STEEL SHEET FINISHES

- A. Repair sheet finish by grinding and polishing irregularities, weld spatter, scratches, and forming marks to match surrounding finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Protect unpainted galvanized- and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating

of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers damaged during installation and construction, so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089119

SECTION 090190.52 - MAINTENANCE REPAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes maintenance repainting as follows:
 - 1. Removing existing paint.
 - 2. Patching substrates.
 - 3. Repainting[, **including staining and varnishing of wood**].
- B. Related Requirements:
 - 1. Section 013516 "Alteration Project Procedures" for general remodeling, renovation, repair, and maintenance requirements.
 - 2. Section 040110 "Masonry Cleaning" for cleaning and removing paint from masonry.
 - 3. Section 050170.51 "Decorative Metal Cleaning" for cleaning and removing paint from decorative metal.
 - 4. Section 099113 "Exterior Painting," Section 099123 "Interior Painting," Section 099300 "Staining and Transparent Finishing," and Section 099600 "High-Performance Coatings" for paint materials and systems for new construction.
 - 5. Section 099423 "Gilding" for gilding surfaces.

1.2 ALLOWANCES

- A. Allowances for maintenance repainting are specified in Section 012100 "Allowances."
 - 1. Perform maintenance repainting under quantity allowances and only as authorized. Authorized work includes [**work required by Drawings and Specifications and**] [**only**] work as directed 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. Provide preconstruction testing as part of testing and inspecting allowance.
- C. Repaint library walls and ceiling as part of **<Insert name of allowance>**.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."
 - 1. Unit prices apply to authorized work covered by [**quantity allowances**] [**estimated quantities**].
 - 2. Unit prices apply to authorized additions to and deletions from Work as authorized by Change Orders.

1.4 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D523.

- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D523.
- H. Low-Pressure Spray: [**100 to 400 psi; 4 to 6 gpm**] **<Insert range of values>**.
- I. Medium-Pressure Spray: [**400 to 800 psi; 4 to 6 gpm**] **<Insert range of values>**.

1.5 PREINSTALLATION MEETINGS

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

1.6 SEQUENCING AND SCHEDULING

- A. Perform maintenance repainting in the following sequence, which includes work specified in this and other Sections:
 - 1. Dismantle existing surface-mounted objects and hardware except items indicated to remain in place. Tag items with location identification and protect.
 - 2. Verify that temporary protections have been installed.
 - 3. Examine condition of surfaces to be painted.
 - 4. Remove existing paint to the degree required for each substrate and surface condition of existing paint.
 - 5. Apply paint system.
 - 6. Reinstall dismantled surface-mounted objects and hardware unless otherwise indicated.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include recommendations for product application and use.
 - 2. Include test data substantiating that products comply with requirements.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
 - 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
- C. Samples: For each type of paint system and each pattern, color, and gloss; [**in sizes indicated below**] [minimum **6 inches long in least dimension, but not less than whole pattern**].
 - 1. Include stepped Samples defining each separate coat, including fillers and primers. Resubmit until each required sheen, color, and texture is achieved.
 - 2. For each painted color being matched to a standardized color-coding system, include the color chips from the color-coding-system company with Samples.
 - 3. Include a list of materials for each coat of each Sample.
 - 4. Label each Sample for location and application.
 - 5. Sample Size:
 - a. Painted Surfaces: [**4-by-8-inch**] **<Insert dimensions>** Samples for each color and material, on hardboard.
 - b. Stained or Natural Wood: [**12-by-12-inch**] **<Insert dimensions>** Samples of

natural- or stained-wood finish, on representative **<Insert required species of wood>** surfaces.

- D. Product List: For each paint product indicated, include the following:
1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 2. Printout of current "MPI Approved Products List" for each MPI-product category specified in paint systems, with the proposed product highlighted.
 3. VOC content.

1.8 INFORMATIONAL SUBMITTALS

- A. Color Matching Certificate: For computer-matched colors.
- B. Preconstruction Test Reports: For cleaning materials, **[paint removers]** **[and]** **[paint coatings and systems]**.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra paint materials, from the same production run, that match products applied and that are packaged with protective covering for storage and identified with labels describing contents, including material, finish, source, and location on building.
1. Quantity: Furnish Owner with an additional **[3]** **[5]** **[7]** **<Insert number>** percent, but not less than **1 gal.** or one case, as appropriate, of each material and color applied.

1.10 QUALITY ASSURANCE

- A. Color Matching: Custom computer-match paint colors to colors indicated **[in maintenance repainting schedule(s) at the end of Part 3]** **[on Drawings]** **<Insert requirement>**. **[For colors indicated by a standardized coding system, obtain a color chip for each color indicated from the color-coding-system company; computer match paint colors to the color chips.]**
- B. Mockups: Prepare mockups of maintenance repainting processes for each type of coating system and substrate indicated and each color and finish required to demonstrate aesthetic effects and to set quality standards for materials and execution. Duplicate appearance of approved Sample submittals.
1. Locate mockups **[on existing surfaces where directed by Architect]** **[in locations that enable viewing under same conditions as the completed Work]** **<Insert requirement>**.
 2. Surface-Preparation Mockups: On existing surfaces using applicable specified methods of cleaning and other surface preparation, provide mockup sample of at least **[100 sq. ft.]** **<Insert dimension>**.
 3. Coating Mockups: **[Two]** **<Insert number>** surfaces of at least **[100 sq. ft.]** **<Insert dimension>** to represent surfaces and conditions for application of each type of coating system under same conditions as the completed Work.
 4. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 5. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.11 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing of cleaning materials, [**paint removers**] [**and**] [**compatibility of paint coatings and systems**] for each[**indicated**] type of painted surface.
 - 1. Use test areas as indicated and representative of proposed materials and existing construction.
 - 2. Propose changes to materials and methods to suit Project.

1.12 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste daily.

1.13 FIELD CONDITIONS

- A. Weather Limitations: Proceed with maintenance repainting only when existing and forecasted weather conditions are within the environmental limits set by each manufacturer's written instructions and specified requirements.
- B. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.
- C. Do not apply paint in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.
 - 1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer for surface preparation and during paint application and drying periods.

PART 2 - PRODUCTS

2.1 PREPARATORY CLEANING MATERIALS

- A. Water: Potable.
- B. Hot Water: Water heated to a temperature of **140 to 160 deg F**.
- C. Detergent Solution: Solution prepared by mixing **2 cups** of tetrasodium pyrophosphate (TSPP), **1/2 cup** of laundry detergent that contains no ammonia, **5 quarts** of 5 percent sodium hypochlorite bleach, and **15 quarts** of warm water for every **5 gal.** of solution required.
- D. Mildewcide: Commercial proprietary mildewcide or a job-mixed solution prepared by mixing **1/3 cup** of household detergent that contains no ammonia, **1 quart** of 5 percent sodium hypochlorite bleach, and **3 quarts** of warm water.
- E. Abrasives for Ferrous Metal Cleaning: Aluminum oxide paper, emery paper, fine steel wool, steel scrapers, and steel-wire brushes of various sizes.
- F. Rust Remover: Manufacturer's standard phosphoric acid-based gel formulation, also called "naval jelly," for removing corrosion from iron and steel.

2.2 PAINT, GENERAL

- A. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- B. Colors: **[As indicated with each paint system in maintenance repainting schedule(s) at the end of Part 3] [Match Architect's samples] [As selected by Architect from full range of industry colors] <Insert requirement>.**

2.3 PAINT MATERIALS, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. VOC Content, LEED 2009: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Clear Wood Finishes, Varnishes: 350 g/L.
 - 9. Clear Wood Finishes, Lacquers: 550 g/L.
 - 10. Floor Coatings: 100 g/L.
 - 11. Shellacs, Clear: 730 g/L.
 - 12. Shellacs, Pigmented: 550 g/L.
 - 13. Stains: 250 g/L.
- C. Low-Emitting Materials, LEED 2009: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. VOC Content, LEED v4: For field applications[**that are inside the weatherproofing system**], paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 50 g/L.
 - 3. Dry-Fog Coatings: 150 g/L.
 - 4. Primers, Sealers, and Undercoaters: 100 g/L.
 - 5. Rust-Preventive Coatings: 100 g/L.
 - 6. Zinc-Rich Industrial Maintenance Primers: 100 g/L.
 - 7. Pretreatment Wash Primers: 420 g/L.
 - 8. Clear Wood Finishes, Varnishes: 275 g/L.

9. Clear Wood Finishes, Lacquers: 275 g/L.
 10. Floor Coatings: 50 g/L.
 11. Shellacs, Clear: 730 g/L.
 12. Shellacs, Pigmented: 550 g/L.
 13. Stains: 100 g/L.
- E. Low-Emitting Materials, LEED v4: For field applications that are inside the weatherproofing system, 90 percent of paints and coatings shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- F. Material Emissions and Pollutant Control: Not less than 85 percent of field-applied paints and coatings that are inside the weatherproofing system shall comply with either of the following:
1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 2. VOC content shall not exceed limits of authorities having jurisdiction and the following:
 - a. Flat Coatings: 50 g/L.
 - b. Nonflat Coatings: 100 g/L.
 - c. Nonflat - High-Gloss Coatings: 150 g/L.
 - d. Concrete/Masonry Sealers: 100 g/L.
 - e. Dry-Fog Coatings: 150 g/L.
 - f. Floor Coatings: 100 g/L.
 - g. Industrial Maintenance Coatings: 250 g/L.
 - h. Low-Solids Coatings: 120 g/L.
 - i. Mastic Texture Coatings: 100 g/L.
 - j. Metallic Pigmented Coatings: 500 g/L.
 - k. Pretreatment Wash Primers: 420 g/L.
 - l. Primers, Sealers, and Undercoaters: 100 g/L.
 - m. Reactive Penetrating Sealers: 350 g/L.
 - n. Recycled Coatings: 250 g/L.
 - o. Rust-Preventive Coatings: 250 g/L.
- G. Emissions Requirements: Field-applied paints and coatings that are inside the weatherproofing system shall comply with either of the following:
1. Low-Emitting Materials: VOC emissions shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 2. VOC content shall not exceed limits of authorities having jurisdiction and the following:
 - a. Flat Coatings: 50 g/L.
 - b. Nonflat Coatings: 100 g/L.
 - c. Primers, Sealers, and Undercoats: 100 g/L.
 - d. Floor Coatings: 100 g/L.
 - e. Shellacs, Clear: 730 g/L.
 - f. Shellacs, Pigmented: 550 g/L.
 - g. Stains: 250 g/L.
 - h. Clear Wood Finishes (Varnishes, Sanding Sealers, and Lacquers): 275 g/L.

- H. VOC Content: For field applications inside the building, wall paints shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
 - 1. Interior Flat Latex Wall Paint: 50 g/L.
 - 2. Interior Nonflat Latex Wall Paint: 150 g/L.
- I. VOC Emissions: For field applications inside the building, wall paints shall contain no more than half of the chronic REL of VOCs when tested according to the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- J. Transition Coat: Paint manufacturer's recommended coating for use where a residual existing coating is incompatible with the paint system.

PART 3 - EXECUTION

3.1 PROTECTION

- A. Comply with each manufacturer's written instructions for protecting building and other surfaces against damage from exposure to its products. Prevent chemical solutions from coming into contact with people, motor vehicles, landscaping, buildings, and other surfaces that could be harmed by such contact.
 - 1. Cover adjacent surfaces with materials that are proven to resist chemical solutions being used unless the solutions will not damage adjacent surfaces. Use protective materials that are UV resistant and waterproof. Apply masking agents to comply with manufacturer's written instructions. Do not apply liquid masking agent to painted or porous surfaces. When no longer needed, promptly remove masking to prevent adhesive staining.
 - 2. Do not apply chemical solutions during winds of sufficient force to spread them to unprotected surfaces.
 - 3. Neutralize and collect alkaline and acid wastes before disposal.
 - 4. Dispose of runoff from operations by legal means and in a manner that prevents soil erosion, undermining of paving and foundations, damage to landscaping, and water penetration into building interiors.

3.2 MAINTENANCE REPAINTING, GENERAL

- A. Maintenance Repainting Appearance Standard: Completed work is to have a uniform appearance as viewed by Architect from building interior at **[5 feet] [10 feet] <Insert distance>** away from painted surface and from building exterior at **[20 feet] [50 feet] <Insert distance>** away from painted surface.
- B. Execution of the Work: In repainting surfaces, disturb them as minimally as possible and as follows:
 - 1. Remove failed coatings and corrosion and repaint.
 - 2. Verify that substrate surface conditions are suitable for repainting.
 - 3. Allow other trades to repair items in place before repainting.
- C. Mechanical Abrasion: Where mechanical abrasion is needed for the work, use gentle methods, such as scraping and lightly hand sanding, that will not abrade softer substrates, reducing clarity of detail.
- D. Heat Processes: Do not use torches, heat guns, or heat plates.

3.3 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of painting work. Comply with paint manufacturer's written instructions for inspection.
- B. Maximum Moisture Content of Substrates: Do not begin application of coatings unless moisture content of exposed surface is below the maximum value recommended in writing by paint manufacturer and not greater than the following maximum values when measured with an electronic moisture meter appropriate to the substrate material:
 - 1. Concrete: [12] <Insert number> percent.
 - 2. Gypsum Board: [12] <Insert number> percent.
 - 3. Gypsum Plaster: [12] <Insert number> percent.
 - 4. Masonry (Clay and CMU): [12] <Insert number> percent.
 - 5. Portland Cement Plaster: [12] <Insert number> percent.
 - 6. Wood: [15] <Insert number> percent.
 - 7. <Insert surface to be repainted>: <Insert number> percent.
- C. Alkalinity: Do not begin application of coatings unless surface alkalinity is within range recommended in writing by paint manufacturer. Conduct alkali testing with litmus paper on exposed plaster, cementitious, and masonry surfaces.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
 - 1. If existing surfaces cannot be prepared to an acceptable condition for proper finishing by using specified surface-preparation methods, notify Architect in writing.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.4 PREPARATORY CLEANING

- A. General: Use the gentlest, appropriate method necessary to clean surfaces in preparation for painting. Clean all surfaces, corners, contours, and interstices.
- B. Detergent Cleaning: Wash surfaces by hand using clean rags, sponges, and bristle brushes. Scrub surface with detergent solution and bristle brush until soil is thoroughly dislodged and can be removed by rinsing. Use small brushes to remove soil from joints and crevices. Dip brush in solution often to ensure that adequate fresh detergent is used and that surface remains wet. Rinse with water applied by clean rags or sponges.
- C. Solvent Cleaning: Use solvent cleaning to remove oil, grease, smoke, tar, and asphalt from painted or unpainted surfaces before other preparation work. Wipe surfaces with solvent using clean rags and sponges. If necessary, spot-solvent cleaning may be employed just prior to commencement of paint application, provided enough time is allowed for complete evaporation. Use clean solvent and clean rags for the final wash to ensure that all foreign materials have been removed. Do not use solvents, including primer thinner and turpentine, that leave residue.

- D. Mildew: Clean off existing mildew, algae, moss, plant material, loose paint, grease, dirt, and other debris by scrubbing with bristle brush or sponge and detergent solution. Scrub mildewed areas with mildewcide. Rinse with water applied by clean rags or sponges.
- E. Chemical Rust Removal:
 - 1. Remove loose rust scale with specified abrasives for ferrous-metal cleaning.
 - 2. Apply rust remover with brushes or as recommended in writing by manufacturer.
 - 3. Allow rust remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing. Do not allow extended dwell time.
 - 4. Wipe off residue with mineral spirits and either steel wool or soft rags, or clean with method recommended in writing by manufacturer to remove residue.
 - 5. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
 - 6. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.
- F. Mechanical Rust Removal:
 - 1. Remove rust with specified abrasives for ferrous-metal cleaning. Clean to bright metal.
 - 2. Wipe off residue with mineral spirits and either steel wool or soft rags.
 - 3. Dry immediately with clean, soft cloths. Follow direction of grain in metal.
 - 4. Prime immediately to prevent rust. Do not touch cleaned metal surface until primed.

3.5 PAINT REMOVAL

- A. General: Remove paint where indicated. Where cleaning methods have been attempted and further removal of the paint is required because of incompatible or unsatisfactory surfaces for repainting, remove paint to extent required by conditions.
 - 1. Application: Apply paint removers according to paint-remover manufacturer's written instructions. Do not allow paint removers to remain on surface for periods longer than those indicated or recommended in writing by manufacturer.
 - a. Apply materials to all surfaces, corners, contours, and interstices, to provide a uniform final appearance without streaks.
 - b. After work is complete, remove protection no longer required. Remove tape and adhesive marks.
 - 2. Brushes: Use brushes that are resistant to chemicals being used.
 - a. Metal Substrates: If using wire brushes on metal, use brushes of same metal composition as metal being treated.
 - b. Wood Substrates: Do not use wire brushes.
 - 3. Spray Equipment: Use spray equipment that provides controlled application at volume and pressure indicated, measured at nozzle. Adjust pressure and volume to ensure that spray methods do not damage surfaces.
 - a. Equip units with pressure gages.
 - b. Unless otherwise indicated, hold spray nozzle at least **6 inches** from surface and apply material in horizontal, back-and-forth sweeping motion, overlapping previous strokes to produce uniform coverage.
 - c. For chemical spray application, use low-pressure tank or chemical pump suitable for chemical indicated, equipped with nozzle having a cone-shaped spray.
 - d. For water-spray application, use fan-shaped spray tip that disperses water at an angle of 25 to 50 degrees.
 - e. For heated water-spray application, use equipment capable of maintaining temperature between **140 and 160 deg F** at flow rates indicated.

- B. Paint Removal with Hand Tools: Remove paint manually using hand-held scrapers, wire brushes, sandpaper, and metallic wool as appropriate for the substrate material.
- C. Paint Removal with Alkaline Paste Paint Remover:
 - 1. Remove loose and peeling paint using[**water,**] scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply paint remover to dry, painted surface with brushes.
 - 3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
 - 4. Rinse with [**cold**] [**hot**] water applied by [**low**] [**medium**]-pressure spray to remove chemicals and paint residue.
 - 5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
 - 6. Repeat process if necessary to remove all paint.
- D. Paint Removal with Covered or Skin-Forming Alkaline Paint Remover:
 - 1. Remove loose and peeling paint using[**water,**] scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply paint remover to dry, painted surface with brushes or as recommended in writing by manufacturer.
 - 3. Apply cover according to manufacturer's written instructions.
 - 4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
 - 5. Scrape off paint and remover.
 - 6. Rinse with [**cold**] [**hot**] water applied by [**low**] [**medium**]-pressure spray to remove chemicals and paint residue.
 - 7. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
 - 8. For spots of remaining paint, apply alkaline paste paint remover according to "Paint Removal with Alkaline Paste Paint Remover" Paragraph.
- E. Paint Removal with Solvent-Type Paste Paint Remover:
 - 1. Remove loose and peeling paint using[**water,**] scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply thick coating of paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap roller, or large paintbrush. Apply in one or two coats according to manufacturer's written instructions.
 - 3. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
 - 4. Rinse with [**cold**] [**hot**] water applied by [**low**] [**medium**]-pressure spray to remove chemicals and paint residue.
 - 5. Use mechanical methods recommended in writing by manufacturer to remove chemicals and paint residue.
 - 6. Repeat process if necessary to remove all paint.
- F. Paint Removal with Covered, Solvent-Type Paste Paint Remover:
 - 1. Remove loose and peeling paint using[**water,**] scrapers, stiff brushes, or a combination of these. Let surface dry thoroughly.
 - 2. Apply paint remover to dry, painted surface with natural-fiber cleaning brush, deep-nap

- roller, or large paint brush or as recommended in writing by manufacturer.
- 3. Apply cover according to manufacturer's written instructions.
- 4. Allow paint remover to remain on surface for period recommended in writing by manufacturer or as determined by preconstruction testing.
- 5. Scrape off paint and remover.
- 6. Rinse with **[cold]** **[hot]** water applied by **[low]** **[medium]**-pressure spray to remove chemicals and paint residue.
- 7. Use mechanical methods recommended in writing by manufacturer to remove remaining chemicals and paint residue.

3.6 SUBSTRATE REPAIR

- A. General: Repair substrate surface defects that are inconsistent with the surface appearance of adjacent materials and finishes.
- B. Wood Substrate:
 - 1. Repair wood defects including dents and gouges more than **[1/8 inch]** **[1/4 inch]** **<Insert dimension>** in size and all holes and cracks by filling with wood-patching compound and sanding smooth. Reset or remove protruding fasteners.
 - 2. Where existing paint is allowed to remain, sand irregular buildup of paint, runs, and sags to achieve a uniformly smooth surface.
- C. Cementitious Material Substrate:
 - 1. General: Repair defects including dents and chips more than **[1/4 inch]** **[1/2 inch]** **<Insert dimension>** in size and all holes and cracks by filling with cementitious patching compound and sanding smooth. Remove protruding fasteners.
 - 2. New and Bare Plaster: Neutralize surface of plaster with mild acid solution as recommended in writing by paint manufacturer. In lieu of acid neutralization, follow manufacturer's written instruction for primer or transition coat over alkaline plaster surfaces.
 - 3. Concrete, Cement Plaster, and Other Cementitious Products: Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. If surfaces are too alkaline to paint, correct this condition before painting.
- D. Gypsum-Plaster and Gypsum-Board Substrates:
 - 1. Repair defects including dents and chips more than **[1/8 inch]** **[1/4 inch]** **<Insert dimension>** in size and all holes and cracks by filling with gypsum-plaster patching compound and sanding smooth. Remove protruding fasteners.
 - 2. Rout out surface cracks to remove loose, unsound material; fill with patching compound and sand smooth.
- E. Metal Substrate:
 - 1. Preparation: Treat repair locations by wire-brushing and solvent cleaning. Use **[chemical]** **[or]** **[mechanical]** rust removal method to clean off rust.
 - 2. Defects in Metal Surfaces: Repair non-load-bearing defects in existing metal surfaces, including dents and gouges more than **[1/16 inch]** **[1/8 inch]** **<Insert dimension>** deep or **[1/2 inch]** **[1 inch]** **<Insert dimension>** across and all holes and cracks by filling with metal-patching compound and sanding smooth. Remove burrs and protruding fasteners.
 - 3. Priming: Prime iron and steel surfaces immediately after repair to prevent flash rusting. Stripe paint corners, crevices, bolts, welds, and sharp edges. Apply two coats to surfaces that are inaccessible after completion of the Work.

3.7 PAINT APPLICATION, GENERAL

- A. Comply with manufacturers' written instructions for application methods unless otherwise indicated in this Section.
- B. Prepare surfaces to be painted according to the Surface-Preparation Schedule and with manufacturer's written instructions for each substrate condition.
- C. Apply a transition coat over incompatible existing coatings.
- D. Metal Substrate: Stripe paint corners, crevices, bolts, welds, and sharp edges before applying full coat. Apply two coats to surfaces that are inaccessible after completion of the Work. Tint stripe coat different than the main coating and apply with brush.
- E. Blending Painted Surfaces: When painting new substrates patched into existing surfaces or touching up missing or damaged finishes, apply coating system specified for the specific substrate. Apply final finish coat over entire surface from edge to edge and corner to corner.

3.8 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage paint-remover manufacturer's factory-authorized service representative for consultation and Project-site inspection and to provide on-site assistance when requested by Architect.
- B. Paint Material Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for composition and dry film thickness.
 - 1. Paint Composition: The following procedure may be performed at any time and as often as Owner deems necessary during the period when paints are being applied:
 - a. Testing agency will sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - b. Testing agency will perform tests for compliance of paint materials with product requirements.
 - c. If test results show materials being used do not comply with product requirements, Contractor shall remove noncomplying-paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.
 - 2. Dry Film Thickness:
 - a. Contractor shall touch up and restore painted surfaces damaged by testing.
 - b. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.9 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.10 SURFACE-PREPARATION SCHEDULE

- A. General: Before painting, prepare surfaces[**where indicated on Drawings**] for painting according to applicable requirements specified in this schedule.
 - 1. Examine surfaces to evaluate each surface condition according to paragraphs below.
 - 2. Where existing degree of soiling prevents examination, preclean surface and allow it to dry before making an evaluation.
 - 3. Repair substrate defects according to "Substrate Repair" Article.
- B. Surface Preparation for [**MPI DSD 0**] <Insert designation> Degree of Surface Degradation:
 - 1. Surface Condition: Existing paint film in good condition and tightly adhered.
 - 2. Paint Removal: Not required.
 - 3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Roughen or degloss cleaned surfaces to ensure paint adhesion according to paint manufacturer's written instructions.
- C. Surface Preparation for [**MPI DSD 1**] <Insert designation> Degree of Surface Degradation:
 - 1. Surface Condition: Paint film cracked or broken but adhered.
 - 2. Paint Removal: Scrape by hand-tool cleaning methods to remove loose paint until only tightly adhered paint remains.
 - 3. Preparation for Painting: Wash surface by detergent cleaning; use other cleaning methods for small areas of bare substrate if required. Roughen, degloss, and sand the cleaned surfaces to ensure paint adhesion and a smooth finish according to paint manufacturer's written instructions.
- D. Surface Preparation for [**MPI DSD 2**] <Insert designation> Degree of Surface Degradation:
 - 1. Surface Condition: Paint film loose, flaking, or peeling.
 - 2. Paint Removal: Remove loose, flaking, or peeling paint film by hand-tool or chemical paint-removal methods.
 - 3. Preparation for Painting: Wash surface by detergent cleaning; use solvent cleaning where needed. Use other cleaning methods for small areas of bare substrate if required. Sand surfaces to smooth remaining paint film edges. Prepare bare cleaned surface to be painted according to paint manufacturer's written instructions for substrate construction materials.
- E. Surface Preparation for [**MPI DSD 3**] <Insert designation> Degree of Surface Degradation:
 - 1. Surface Condition: Paint film [**severely deteriorated**] [**obscuring fine architectural detail work because of paint-layer buildup**] [**and**] [**surface indicated to have paint completely removed**].
 - 2. Paint Removal: Completely remove paint film by hand-tool or chemical paint-removal methods. Remove rust.
 - 3. Preparation for Painting: Prepare bare cleaned surface according to paint manufacturer's written instructions for substrate construction materials.

F. Surface Preparation for [MPI DSD 4] <Insert designation> Degree of Surface Degradation:

1. Surface Condition: Missing material, small holes and openings, and deteriorated or corroded substrate.
2. Substrate Preparation: Repair, replace, and treat substrate according to "Substrate Repair" Article[**and requirements in other Specification Sections**].
3. Preparation for Painting: Sand substrate surfaces to smooth remaining paint film edges and prepare according to paint manufacturer's written instructions for substrate construction materials. Remove rust.
4. Painting: Paint as required for [MPI DSD 2] <Insert designation> degree of surface degradation.

3.11 EXTERIOR MAINTENANCE REPAINTING SCHEDULE

A. Ferrous Metal Substrates: [Iron railing and gate] <Insert item description or drawing designation, or both>:

1. Alkyd System: [MPI REX 5.1D] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant[, MPI #23].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant[, MPI #23].
 - b. Intermediate Coat: [Alkyd, exterior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, exterior, semigloss (Gloss Level 5)[, MPI #94].
 - 2) Alkyd, exterior, gloss (Gloss Level 6)[, MPI #9].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
2. High-Performance, Pigmented-Polyurethane-over-Epoxy System: [MPI REX 5.1H] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Epoxy, Anti-Corrosive, for Metal[, MPI #101].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Epoxy, Anti-Corrosive, for Metal[, MPI #101].
 - b. Intermediate Coat in Primed Areas: Epoxy, High Build, Low Gloss[, MPI #108].
 - c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, MPI #72].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, MPI #72].
 - e. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.

- B. Wood [Columns] [Beams] [Ceilings] [Siding] [and] [Fencing] <Insert item description or drawing designation, or both>:
1. Latex System: [MPI REX 6.2A] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood[, MPI #5].
 - 3) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Latex for Exterior Wood[, MPI #6].
 - 4) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood[, MPI #5].
 - 5) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Latex for Exterior Wood[, MPI #6].
 - b. Intermediate Coat: [Latex, exterior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, exterior flat (Gloss Levels 1-2)[, MPI #10].
 - 2) Latex, exterior, low sheen (Gloss Levels 3-4)[, MPI #15].
 - 3) Latex, exterior semigloss (Gloss Level 5)[, MPI #11].
 - 4) Latex, exterior gloss (Gloss Level 6)[, MPI #119].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
 2. Alkyd System: [MPI REX 6.2C] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood[, MPI #5].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood[, MPI #5].
 - b. Intermediate Coat: [Latex, exterior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, exterior flat (Gloss Level 1)[, MPI #8].
 - 2) Alkyd, exterior semigloss (Gloss Level 5)[, MPI #94].
 - 3) Alkyd, exterior gloss (Gloss Level 6)[, MPI #9].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
- C. Wood [Doors] [Windows] [Frames] [Casings] [and] [Smooth Fasciae] <Insert item description or drawing designation, or both>:
1. Latex System: [MPI REX 6.3A] <Insert system description> system[over a transition coat].
 - a. Prime Coat:

- 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood[, MPI #5].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood[, MPI #5].
 - b. Intermediate Coat: [Latex, exterior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, exterior flat (Gloss Levels 1-2)[, MPI #10].
 - 2) Latex, exterior, low sheen (Gloss Levels 3-4)[, MPI #15].
 - 3) Latex, exterior semigloss (Gloss Level 5)[, MPI #11].
 - 4) Latex, exterior gloss (Gloss Level 6)[, MPI #119].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
2. Alkyd System: [MPI REX 6.3B] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood[, MPI #5].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood[, MPI #5].
 - b. Intermediate Coat: [Alkyd, exterior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, exterior flat (Gloss Level 1)[, MPI #8].
 - 2) Alkyd, exterior semigloss (Gloss Level 5)[, MPI #94].
 - 3) Alkyd, exterior gloss (Gloss Level 6)[, MPI #9].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
3. Varnish System (Clear): [MPI REX 6.3F] <Insert system description>.
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with topcoat.
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with topcoat.
 - b. Intermediate Coat: [Exterior varnish matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Varnish, with UV inhibitor, exterior, semigloss (Gloss Level 5)[, MPI #30].
 - 2) Varnish, with UV inhibitor, exterior, gloss (Gloss Level 6)[, MPI #29].
 - 3) Varnish, marine spar, exterior, gloss (Gloss Level 6)[, MPI #28].

D. Wood [Deck] [and] [Stairs] <Insert item description or drawing designation, or both>:

1. Latex Porch and Floor System over Alkyd Primer: [MPI REX 6.5A] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd/Oil for Exterior Wood[, MPI #5].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd/Oil for Exterior Wood[, MPI #5].
 - b. Intermediate Coat: [Floor Paint, Latex, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Floor paint, latex, low gloss[, MPI #60].
 - 2) Floor paint, latex, gloss[, MPI #68].
 - d. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
 - e. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
 2. Alkyd Floor Enamel System: [MPI REX 6.5B] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with topcoat.
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with topcoat.
 - b. Intermediate Coat: [Floor enamel matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Floor paint, alkyd, low gloss[, MPI #59].
 - 2) Floor enamel, alkyd, gloss (Gloss Level 6)[, MPI #27].
 - d. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
 - e. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
- E. Wood [Shingle] [Shake] Siding <Insert item description or drawing designation, or both>:
1. Latex System: [MPI REX 6.6A] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood[, MPI #5].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood[, MPI #5].

- b. Intermediate Coat: [**Latex, exterior, matching topcoat**] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, exterior flat (Gloss Levels 1-2)[, **MPI #10**].
 - 2) Latex, exterior, low sheen (Gloss Levels 3-4)[, **MPI #15**].
 - 3) Latex, exterior semigloss (Gloss Level 5)[, **MPI #11**].
 - 4) Latex, exterior gloss (Gloss Level 6)[, **MPI #119**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] <Insert color(s) or requirement>.
2. Alkyd System: [**MPI REX 6.6B**] <Insert system description> system[**over a transition coat**].
- a. Prime Coat:
 - 1) For [**MPI DSD 1**] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd for Exterior Wood[, **MPI #5**].
 - 3) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd for Exterior Wood[, **MPI #5**].
 - b. Intermediate Coat: [**Latex, exterior, matching topcoat**] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, exterior flat (Gloss Level 1)[, **MPI #8**].
 - 2) Alkyd, exterior semigloss (Gloss Level 5)[, **MPI #94**].
 - 3) Alkyd, exterior gloss (Gloss Level 6)[, **MPI #9**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] <Insert color(s) or requirement>.

3.12 INTERIOR MAINTENANCE REPAINTING SCHEDULE

- A. Ferrous Metal Substrates: [**Iron railing**] <Insert item description or drawing designation, or both>:
- 1. Latex System: [**MPI RIN 5.1N**] <Insert system description> system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant[, **MPI #23**].
 - 3) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal[, **MPI #79**].
 - 4) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Rust-Inhibitive, Water Based[, **MPI #107**].
 - 5) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant[, **MPI #23**].
 - 6) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal[, **MPI #79**].
 - 7) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Rust-Inhibitive, Water Based[, **MPI #107**].

- b. Intermediate Coat: [**Latex matching topcoat**] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior, flat (Gloss Level 1)[, **MPI #53**].
 - 2) Latex, interior (Gloss Level 2)[, **MPI #44**].
 - 3) Latex, interior (Gloss Level 3)[, **MPI #52**].
 - 4) Latex, interior (Gloss Level 4)[, **MPI #43**].
 - 5) Latex, interior, semigloss (Gloss Level 5)[, **MPI #54**].
 - 6) Latex, interior, gloss (Gloss Level 6)[, **MPI #114**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
2. Alkyd System: [**MPI RIN 5.1E**] <Insert system description> system[over a transition coat].
- a. Prime Coat:
 - 1) For [**MPI DSD 1**] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Metal, Surface Tolerant[, **MPI #23**].
 - 3) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Alkyd, Anti-Corrosive for Metal[, **MPI #79**].
 - 4) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Metal, Surface Tolerant[, **MPI #23**].
 - 5) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Alkyd, Anti-Corrosive for Metal[, **MPI #79**].
 - b. Intermediate Coat: [**Alkyd, matching topcoat**] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - 2) Alkyd, interior (Gloss Level 3)[, **MPI #51**].
 - 3) Alkyd, interior, semigloss (Gloss Level 5)[, **MPI #47**].
 - 4) Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
3. High-Performance, Pigmented-Polyurethane-over-Epoxy System: [**MPI RIN 5.1H**] <Insert system description> system[over a transition coat].
- a. Prime Coat:
 - 1) For [**MPI DSD 1**] <Insert designation> degree of surface degradation, touch up with Epoxy, Gloss[, **MPI #77**].
 - 2) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Zinc Rich, Organic[, **MPI #18**].
 - 3) For [**MPI DSD 2**] <Insert designation> degree of surface degradation, spot prime with Primer, Zinc Rich, Epoxy[, **MPI #20**].
 - 4) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Zinc Rich, Organic[, **MPI #18**].
 - 5) For [**MPI DSD 3**] <Insert designation> degree of surface degradation, fully prime coat with Primer, Zinc Rich, Epoxy[, **MPI #20**].
 - b. Intermediate Coat in Primed Areas: Epoxy, Gloss[, **MPI #77**].

- c. Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - d. Second Topcoat: Polyurethane, two-component, pigmented, gloss (Gloss Level 6)[, **MPI #72**].
 - e. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
- B. Wood [Columns] [Beams] [and] [Ceilings] <Insert item description or drawing designation, or both>:**
- 1. Latex System over Latex Primer: [**MPI RIN 6.2D**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer, Latex, for Interior Wood[, **MPI #39**].
 - 3) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood[, **MPI #39**].
 - b. Intermediate Coat: [**Latex, interior, matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Latex, interior flat (Gloss Level 1)[, **MPI #53**].
 - 2) Latex, interior (Gloss Level 2)[, **MPI #44**].
 - 3) Latex, interior (Gloss Level 3)[, **MPI #52**].
 - 4) Latex, interior (Gloss Level 4)[, **MPI #43**].
 - 5) Latex, interior, semigloss (Gloss Level 5)[, **MPI #54**].
 - 6) Latex, interior, gloss (Gloss Level 6)[, **MPI #114**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
 - 2. Latex System over Alkyd Primer: [**MPI RIN 6.2A**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Undercoat, Enamel, Interior[, **MPI #46**].
 - 3) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior[, **MPI #46**].
 - b. Intermediate Coat: [**Latex, interior, matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Latex, interior flat (Gloss Level 1)[, **MPI #53**].
 - 2) Latex, interior (Gloss Level 2)[, **MPI #44**].
 - 3) Latex, interior (Gloss Level 3)[, **MPI #52**].
 - 4) Latex, interior (Gloss Level 4)[, **MPI #43**].
 - 5) Latex, interior, semigloss (Gloss Level 5)[, **MPI #54**].
 - 6) Latex, interior, gloss (Gloss Level 6)[, **MPI #114**].

- d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
- 3. Alkyd System: [MPI RIN 6.2C] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Undercoat, Enamel, Interior[, MPI #46].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior[, MPI #46].
 - b. Intermediate Coat: [Alkyd, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, interior, flat (Gloss Level 1)[, MPI #49].
 - 2) Alkyd, interior (Gloss Level 3)[, MPI #51].
 - 3) Alkyd, interior, semigloss (Gloss Level 5)[, MPI #47].
 - 4) Alkyd, interior, gloss (Gloss Level 6)[, MPI #48].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
- C. Wood [Doors] [Windows] [Frames] [and] [Moldings] <Insert item description or drawing designation, or both>:
 - 1. Latex System over Latex Primer: [MPI RIN 6.3U] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Latex, for Interior Wood[, MPI #39].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood[, MPI #39].
 - b. Intermediate Coat: [Latex, interior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior, semigloss (Gloss Level 5)[, MPI #54].
 - 2) Latex, interior, gloss (Gloss Level 6)[, MPI #114].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
 - 2. Low-Odor Latex System over Latex Primer: [MPI RIN 6.3V] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Latex, for Interior Wood[, MPI #39].

- 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood[, MPI #39].
 - b. Intermediate Coat: [Latex, interior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior, institutional low odor/VOC flat (Gloss Level 1)[, MPI #143].
 - 2) Latex, interior, institutional low odor/VOC (Gloss Level 2)[, MPI #144].
 - 3) Latex, interior, institutional low odor/VOC (Gloss Level 3)[, MPI #145].
 - 4) Latex, interior, institutional low odor/VOC (Gloss Level 4)[, MPI #146].
 - 5) Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5)[, MPI #147].
 - 6) Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6)[, MPI #148].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
3. Latex System over Alkyd Primer: [MPI RIN 6.3A] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Undercoat, Enamel, Interior[, MPI #46].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior[, MPI #46].
 - b. Intermediate Coat: [Latex, interior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior, semigloss (Gloss Level 5)[, MPI #54].
 - 2) Latex, interior, gloss (Gloss Level 6)[, MPI #114].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
4. Alkyd System: [MPI RIN 6.3B] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Undercoat, Enamel, Interior[, MPI #46].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior[, MPI #46].
 - b. Intermediate Coat: [Alkyd, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, interior, semigloss (Gloss Level 5)[, MPI #47].
 - 2) Alkyd, interior, gloss (Gloss Level 6)[, MPI #48].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399]

- [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
5. Alkyd Varnish System (Clear): [MPI RIN 6.3J] <Insert system description>.
 - a. Prime Coat:
 - b. For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 1) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Shellac[, MPI #88].
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Alkyd, Sanding Sealer, Clear[, MPI #102].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Shellac[, MPI #88].
 - 4) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Alkyd, Sanding Sealer, Clear[, MPI #102].
 - c. Intermediate Coat: [Interior varnish matching topcoat] <Insert requirement or coating designation>.
 - d. Topcoat:
 - 1) Varnish, interior, flat (Gloss Level 1)[, MPI #73].
 - 2) Varnish, interior, semigloss (Gloss Level 5)[, MPI #74].
 - 3) Varnish, interior, gloss (Gloss Level 6)[, MPI #75].
 - D. Wood [Paneling] [Casework] [and] [Millwork] <Insert item description or drawing designation, or both>:
 1. Latex System over Latex Primer: [MPI RIN 6.4T] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Latex, for Interior Wood[, MPI #39].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood[, MPI #39].
 - b. Intermediate Coat: [Latex, interior, matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior, semigloss (Gloss Level 5)[, MPI #54].
 - 2) Latex, interior, gloss (Gloss Level 6)[, MPI #114].
 - d. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
 2. Low-Odor Latex System over Latex Primer: [MPI RIN 6.4D] <Insert system description> system[over a transition coat].
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Primer, Latex, for Interior Wood[, MPI #39].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Primer, Latex, for Interior Wood[, MPI #39].

- b. Intermediate Coat: **[Latex, interior, matching topcoat]** <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior, institutional low odor/VOC flat (Gloss Level 1)[, **MPI #143**].
 - 2) Latex, interior, institutional low odor/VOC (Gloss Level 2)[, **MPI #144**].
 - 3) Latex, interior, institutional low odor/VOC (Gloss Level 3)[, **MPI #145**].
 - 4) Latex, interior, institutional low odor/VOC (Gloss Level 4)[, **MPI #146**].
 - 5) Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5)[, **MPI #147**].
 - 6) Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6)[, **MPI #148**].
 - d. Color: Match **[Munsell Color 10 G 8/2]** **[Plochere Color System #8da399]** **[existing colors]** **[colors indicated on Drawings]** <Insert color(s) or requirement>.
3. Latex System over Alkyd Primer: **[MPI RIN 6.4A]** <Insert system description> system[**over a transition coat**].
- a. Prime Coat:
 - 1) For **[MPI DSD 1]** <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For **[MPI DSD 2]** <Insert designation> degree of surface degradation, spot prime with Undercoat, Enamel, Interior[, **MPI #46**].
 - 3) For **[MPI DSD 3]** <Insert designation> degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior[, **MPI #46**].
 - b. Intermediate Coat: **[Latex, interior, matching topcoat]** <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Latex, interior flat (Gloss Level 1)[, **MPI #53**].
 - 2) Latex, interior (Gloss Level 2)[, **MPI #44**].
 - 3) Latex, interior (Gloss Level 3)[, **MPI #52**].
 - 4) Latex, interior (Gloss Level 4)[, **MPI #43**].
 - 5) Latex, interior, semigloss (Gloss Level 5)[, **MPI #54**].
 - 6) Latex, interior, gloss (Gloss Level 6)[, **MPI #114**].
 - d. Color: Match **[Munsell Color 10 G 8/2]** **[Plochere Color System #8da399]** **[existing colors]** **[colors indicated on Drawings]** <Insert color(s) or requirement>.
4. Alkyd System: **[MPI RIN 6.4C]** <Insert system description> system[**over a transition coat**].
- a. Prime Coat:
 - 1) For **[MPI DSD 1]** <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For **[MPI DSD 2]** <Insert designation> degree of surface degradation, spot prime with Undercoat, Enamel, Interior[, **MPI #46**].
 - 3) For **[MPI DSD 3]** <Insert designation> degree of surface degradation, fully prime coat with Undercoat, Enamel, Interior[, **MPI #46**].
 - b. Intermediate Coat: **[Alkyd, matching topcoat]** <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Alkyd, interior flat (Gloss Level 1)[, **MPI #49**].

- 2) Alkyd, interior (Gloss Level 3)[, **MPI #51**].
 - 3) Alkyd, interior, semigloss (Gloss Level 5)[, **MPI #47**].
 - 4) Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
 5. Alkyd Varnish System over Stain: [**MPI RIN 6.4F**] **<Insert system description>**.
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Stain, Semi-Transparent, for Interior Wood[, **MPI #90**].
 - 3) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Stain, Semi-Transparent, for Interior Wood[, **MPI #90**].
 - b. Intermediate Coat: [**Interior varnish matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Varnish, interior, flat (Gloss Level 1)[, **MPI #73**].
 - 2) Varnish, interior, semigloss (Gloss Level 5)[, **MPI #74**].
 - 3) Varnish, interior, gloss (Gloss Level 6)[, **MPI #75**].
 - d. Stain Color: Match [**adjacent, cleaned wood of same type**] [**existing color**] [**color indicated on Drawings**] **<Insert color or requirement>**.
- E. Wood [**Floors**] [**and**] [**Stairs**] **<Insert item description or drawing designation, or both>**:
1. Latex Porch and Floor System over Alkyd Primer: [**MPI RIN 6.5J**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer Sealer, Alkyd, Interior[, **MPI #45**].
 - 3) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer Sealer, Alkyd, Interior[, **MPI #45**].
 - b. Intermediate Coat: [**Floor Paint, Latex, matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Floor paint, latex, low gloss[, **MPI #60**].
 - 2) Floor paint, latex, gloss[, **MPI #68**].
 - d. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
 - e. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
 2. Alkyd Floor Enamel System: [**MPI RIN 6.5A**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.

- 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with topcoat.
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with topcoat.
 - b. Intermediate Coat: [Floor enamel matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat:
 - 1) Floor paint, alkyd, low gloss[, MPI #59].
 - 2) Floor enamel, alkyd, gloss (Gloss Level 6)[, MPI #27].
 - d. Topcoat Additive: Manufacturer's standard additive to increase skid resistance of painted surface.
 - e. Color: Match [Munsell Color 10 G 8/2] [Plochere Color System #8da399] [existing colors] [colors indicated on Drawings] <Insert color(s) or requirement>.
3. Polyurethane Varnish System (Clear): [MPI RIN 6.5C] <Insert system description>.
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with topcoat.
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with topcoat.
 - b. Intermediate Coat: [Interior varnish matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat: Varnish, interior, polyurethane, oil modified, gloss[, MPI #56].
4. Two-Component Aliphatic Polyurethane System (Clear): [MPI RIN 6.5G] <Insert system description>.
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with topcoat.
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with topcoat.
 - b. Intermediate Coat: [Aliphatic polyurethane varnish matching topcoat] <Insert requirement or coating designation>.
 - c. Topcoat: Varnish, aliphatic polyurethane, two-component[, MPI #78].
5. Moisture-Cured Polyurethane System (over Stain): [MPI RIN 6.5L] <Insert system description>.
 - a. Prime Coat:
 - 1) For [MPI DSD 1] <Insert designation> degree of surface degradation, touch up with topcoat.
 - 2) For [MPI DSD 2] <Insert designation> degree of surface degradation, spot prime with Stain, Semi-Transparent, for Interior Wood[, MPI #90].
 - 3) For [MPI DSD 3] <Insert designation> degree of surface degradation, fully prime coat with Stain, Semi-Transparent, for Interior Wood[, MPI #90].
 - b. Intermediate Coat: [Moisture-cured polyurethane varnish matching topcoat] <Insert requirement or coating designation>.

- c. Topcoat: Varnish, polyurethane, moisture cured, gloss (Gloss Level 6)[, **MPI #31**].
 - d. Stain Color: Match [**adjacent, cleaned wood of same type**] [**existing color**] [**color indicated on Drawings**] **<Insert color or requirement>**.
- F. **[Plaster] <Insert item description or drawing designation, or both>**:
- 1. Latex System over Waterborne Primer: [**MPI RIN 9.2A**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer Sealer, Latex, Interior[, **MPI #50**].
 - 3) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer, Stain Blocking, Water Based[, **MPI #137**].
 - 4) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer Sealer, Latex, Interior[, **MPI #50**].
 - 5) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer, Stain Blocking, Water Based[, **MPI #137**].
 - b. Intermediate Coat: [**Latex matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Latex, interior, flat (Gloss Level 1)[, **MPI #53**].
 - 2) Latex, interior (Gloss Level 2)[, **MPI #44**].
 - 3) Latex, interior (Gloss Level 3)[, **MPI #52**].
 - 4) Latex, interior (Gloss Level 4)[, **MPI #43**].
 - 5) Latex, interior, semigloss (Gloss Level 5)[, **MPI #54**].
 - 6) Latex, interior, gloss (Gloss Level 6)[, **MPI #114**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
 - 2. Low-Odor Latex System over Waterborne Primer: [**MPI RIN 9.2M**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer Sealer, Latex, Interior[, **MPI #50**].
 - 3) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer, Stain Blocking, Water Based[, **MPI #137**].
 - 4) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer Sealer, Latex, Interior[, **MPI #50**].
 - 5) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer, Stain Blocking, Water Based[, **MPI #137**].
 - b. Topcoat:
 - 1) Latex, interior, institutional low odor/VOC flat (Gloss Level 1)[, **MPI #143**].
 - 2) Latex, interior, institutional low odor/VOC (Gloss Level 2)[, **MPI #144**].
 - 3) Latex, interior, institutional low odor/VOC (Gloss Level 3)[, **MPI #145**].
 - 4) Latex, interior, institutional low odor/VOC (Gloss Level 4)[, **MPI #146**].

- 5) Latex, interior, institutional low odor/VOC, semigloss (Gloss Level 5)[, **MPI #147**].
- 6) Latex, interior, institutional low odor/VOC, gloss (Gloss Level 6)[, **MPI #148**].
- c. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
3. Latex System over Alkyd Primer: [**MPI RIN 9.2K**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer Sealer, Alkyd, Interior[, **MPI #45**].
 - 3) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat Primer Sealer, Alkyd, Interior[, **MPI #45**].
 - b. Intermediate Coat: [**Latex matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Latex, interior, flat (Gloss Level 1)[, **MPI #53**].
 - 2) Latex, interior (Gloss Level 2)[, **MPI #44**].
 - 3) Latex, interior (Gloss Level 3)[, **MPI #52**].
 - 4) Latex, interior (Gloss Level 4)[, **MPI #43**].
 - 5) Latex, interior, semigloss (Gloss Level 5)[, **MPI #54**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or requirement>**.
4. Alkyd System: [**MPI RIN 9.2C**] **<Insert system description>** system[**over a transition coat**].
 - a. Prime Coat:
 - 1) For [**MPI DSD 1**] **<Insert designation>** degree of surface degradation, touch up with topcoat.
 - 2) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer Sealer, Latex, Interior[, **MPI #50**].
 - 3) For [**MPI DSD 2**] **<Insert designation>** degree of surface degradation, spot prime with Primer, Stain Blocking, Water Based[, **MPI #137**].
 - 4) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer Sealer, Latex, Interior[, **MPI #50**].
 - 5) For [**MPI DSD 3**] **<Insert designation>** degree of surface degradation, fully prime coat with Primer, Stain Blocking, Water Based[, **MPI #137**].
 - b. Intermediate Coat: [**Alkyd, matching topcoat**] **<Insert requirement or coating designation>**.
 - c. Topcoat:
 - 1) Alkyd, interior, flat (Gloss Level 1)[, **MPI #49**].
 - 2) Alkyd, interior (Gloss Level 3)[, **MPI #51**].
 - 3) Alkyd, interior, semigloss (Gloss Level 5)[, **MPI #47**].
 - 4) Alkyd, interior, gloss (Gloss Level 6)[, **MPI #48**].
 - d. Color: Match [**Munsell Color 10 G 8/2**] [**Plochere Color System #8da399**] [**existing colors**] [**colors indicated on Drawings**] **<Insert color(s) or**

requirement>.

END OF SECTION 090190.52

SECTION 090561.13 - MOISTURE VAPOR EMISSION CONTROL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.2 ALLOWANCES

- A. Concrete MVE-control systems are part of [Moisture Vapor Emission Control Allowance] <Insert allowance>.**

1.3 UNIT PRICES

- A. Work of this Section is affected by [Moisture Vapor Emission Control Unit Price] <Insert unit price>.**

1.4 DEFINITIONS

- A. MVE: Moisture vapor emission.**
- B. MVER: Moisture vapor emission rate.**

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.**
- B. Sustainable Design Submittals:**
1. Product Data: For coatings, indicating VOC content.
 2. Laboratory Test Reports: For coatings, indicating compliance with requirements for low-emitting materials.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For [Installer] [manufacturer].**
- B. Product Test Reports: For each MVE-control system, for tests performed by [manufacturer and witnessed by a qualified testing agency] [a qualified testing agency].**
- C. Preinstallation testing reports.**
- D. Field quality-control reports.**

1.7 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.**
- B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.**

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing**

manufacturer's labels indicating directions for storage and mixing with other components.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
 - 1. Store system components in a temperature-controlled environment and protected from weather and at ambient temperature of not less than **65 deg F** and not more than **85 deg F** at least 48 hours before use.
 - 2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than **65 deg F** or more than **85 deg F** and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
 - 3. Install MVE-control systems where concrete surface temperatures will remain a minimum of **5 deg F** higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
 - 1. MVER: Maximum [**15 lb of water/1000 sq. ft.**] [**25 lb of water/1000 sq. ft.**] [**30 lb of water/1000 sq. ft.**] <Insert rate> when tested according to ASTM F1869.
 - 2. Relative Humidity: Maximum [**100**] [**90**] <Insert number> percent when tested according to ASTM F2170 using in situ probes.
- B. Water-Vapor Transmission: Through MVE-control system, maximum [**0.10 perm**] [**0.02 perm**] [**0.06 perm**] when tested according to ASTM E96/E96M.
- C. Tensile Bond Strength: For MVE-control system, greater than [**200 psi**] <Insert pressure> with failure in the concrete according to ASTM D7234.

2.2 ACCESSORIES

- A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of [**3000-psi**] <Insert pressure> compressive strength after 28 days when tested according to ASTM C109/C109M.
- B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.
- C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's [**gypsum**] [**hydraulic**] cement-based underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance

of the Work.

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

1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Preinstallation Testing:

1. Testing Agency: [Owner will engage] [Engage] a qualified testing agency to perform tests.
2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than [7.0] <Insert value> and in areas where pH readings are greater than [8.5] <Insert value>.
3. Moisture Testing: Perform tests so that each test area does not exceed [200 sq. ft.] [1000 sq. ft.] <Insert dimension>, and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
 - a. Anhydrous Calcium Chloride Test: ASTM F1869. Install MVE-control system in locations where concrete substrate MVER exceeds [3 lb of water/1000 sq. ft.] <Insert rate> in 24 hours.
 - b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than [75] <Insert number> percent.
4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum [100-sq. ft.] <Insert dimension> area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.
 - a. Proceed with installation only where tensile bond strength is greater than [200 psi] <Insert pressure> with failure in the concrete.

- B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.

1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile complying with ICRI 310.2R [CSP 3] <Insert requirements> by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
5. Fill surface depressions and irregularities with patching and leveling material.
6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

- C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

- A. Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
 - 1. Install primers as required to comply with manufacturer's written instructions.
- B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.
- C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.
- D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.
- E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.
- F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: **[Owner will engage] [Engage]** a qualified testing agency to perform installation inspections.
- B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
 - 1. Verify that surface preparation meets requirements.
 - 2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
 - 3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.
- C. MVE-control system will be considered defective if it does not pass inspections.

3.5 PROTECTION

- A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.
- B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION 090561.13

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing steel framing systems for interior partitions.
 - 2. Suspension systems for interior ceilings and soffits.
 - 3. Grid suspension systems for gypsum board ceilings.
- B. Related Requirements:
 - 1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For **[embossed, high-strength steel studs and tracks] [firestop tracks] [post-installed anchors] [and] [power-actuated fasteners]**, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of **[the Certified Steel Stud Association] [the Steel Framing Industry Association] [the Steel Stud Manufacturers Association] [or] [the Supreme Steel Framing System Association]**.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For [**composite**] [**non-composite**] wall assemblies, limited to [**1/240**] [**1/360**] of the wall height based on horizontal loading of [**5 lbf/sq. ft.**] [**10 lbf/sq. ft.**] <Insert value>.
- D. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- E. Design Loads: As indicated on architectural Drawings or **5 lbf/sq. ft.** minimum as required by the IBC.
- F. Design framing systems to accommodate deflection of primary building structure and construction tolerances and to withstand design loads with a maximum deflection of <Insert inches>.

2.2 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide[**one of**] the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch** thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches** o.c.

2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Single-Layer Application: [**As required by horizontal deflection performance requirements**] [**16 inches o.c.**] [**24 inches o.c.**] unless otherwise indicated.
 2. Multilayer Application: [**As required by horizontal deflection performance requirements**] [**16 inches o.c.**] [**24 inches o.c.**] unless otherwise indicated.
 3. Tile Backing Panels: [**As required by horizontal deflection performance requirements**] [**16 inches o.c.**] unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.

- a. Install two studs at each jamb unless otherwise indicated.
- b. Install cripple studs at head adjacent to each jamb stud, with a minimum **1/2-inch** clearance from jamb stud to allow for installation of control joint in finished assembly.
- c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs **6 inches** o.c.
- E. Direct Furring:
 1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** o.c.
- F. Z-Shaped Furring Members:
 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced [**24 inches**] **<Insert dimension>** o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches** o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than **12 inches** from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch** from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092400 - CEMENT PLASTERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Base-coat cement plaster.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings:** Show locations and installation of control and expansion joints, including plans, elevations, sections, details of components, and attachments to other work.

- C. Samples:** For each type of factory-prepared finish coat and for each color and texture specified.

- D. Samples for Initial Selection:** For each type of factory-prepared finish coat and for each color and texture specified.

- E. Samples for Verification:** For each type of factory-prepared finish coat and for each color and texture specified, **12 by 12 inches**, and prepared on rigid backing.

- F. Sustainable Design Submittals:**

1. **Product Data:** For recycled content, indicating postconsumer and preconsumer recycled content and cost.

1.4 MOCKUPS

- A. Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.**

1. Build mockups for each substrate and finish texture indicated for cement plastering, including accessories.
 - a. Size: **[100 sq. ft.]** <Insert dimension> in surface area.
2. For interior plasterwork, simulate finished lighting conditions for review of mockups.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover, and keep them dry and protected against damage from weather, moisture, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.**

1.6 FIELD CONDITIONS

- A. Comply with ASTM C926 requirements.**

- B. Exterior Plasterwork:
 - 1. Apply and cure plaster to prevent plaster drying out during curing period. Use procedures required by climatic conditions, including moist curing, providing coverings, and providing barriers to deflect sunlight and wind.
 - 2. Apply plaster when ambient temperature is greater than **40 deg F**.
 - 3. Protect plaster coats from freezing for not less than 48 hours after set of plaster coat has occurred.
- C. Interior Plasterwork: Maintain room temperatures at greater than **40 deg F** for at least 48 hours before plaster application, and continuously during and after application.
 - 1. Avoid conditions that result in plaster drying out during curing period. Distribute heat evenly; prevent concentrated or uneven heat on plaster.
 - 2. Ventilate building spaces as required to remove water in excess of that required for hydrating plaster in a manner that prevents drafts of air from contacting surfaces during plaster application and until plaster is dry.
- D. Factory-Prepared Finishes: Comply with manufacturer's written recommendations for environmental conditions for applying finishes.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain plaster materials from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Ratings: Where indicated, provide cement plaster assemblies identical to those of assemblies tested for fire resistance according to ASTM E119 by a qualified testing agency.

2.3 BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926 for applications indicated.
 - 1. Fiber Content: Add fiber to base-coat mixes after ingredients have mixed at least two minutes. Comply with fiber manufacturer's written instructions for fiber quantities in mixes, but do not exceed **1 lb of fiber/cu. yd.** of cementitious materials.
- B. Base-Coat Mixes for Use over Metal Lath: Scratch and brown coats for three-coat plasterwork as follows:
 - 1. Portland Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and **[0 to 3/4]** **[3/4 to 1-1/2]** parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part portland cement and **[0 to 3/4]** **[3/4 to 1-1/2]** parts lime. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
 - 2. Masonry Cement Mixes:
 - a. Scratch Coat: Mix 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: Mix 1 part masonry cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
 - 3. Portland and Masonry Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.

- b. Brown Coat: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
 - 4. Plastic Cement Mixes:
 - a. Scratch Coat: Mix 1 part plastic cement and 2-1/2 to 4 parts aggregate.
 - b. Brown Coat: Mix 1 part plastic cement and 3 to 5 parts aggregate, but not less than volume of aggregate used in scratch coat.
 - 5. Portland and Plastic Cement Mixes:
 - a. Scratch Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - b. Brown Coat: For cementitious material, mix 1 part plastic cement and 1 part portland cement. Use 3 to 5 parts aggregate per part of cementitious material, but not less than volume of aggregate used in scratch coat.
- C. Base-Coat Mixes for Use over Low-Absorption Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on low-absorption plaster bases as follows:
 - 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 0 to 3/4 part lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 3. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.
- D. Base-Coat Mixes for Use over High-Absorption Unit Masonry and Concrete: Single base (scratch) coat for two-coat plasterwork on high-absorption plaster bases as follows:
 - 1. Portland Cement Mix: For cementitious material, mix 1 part portland cement and 3/4 to 1-1/2 parts lime. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 2. Masonry Cement Mix: Use 1 part masonry cement and 2-1/2 to 4 parts aggregate.
 - 3. Portland and Masonry Cement Mix: For cementitious material, mix 1 part portland cement and 1 part masonry cement. Use 2-1/2 to 4 parts aggregate per part of cementitious material.
 - 4. Plastic Cement Mix: Use 1 part plastic cement and 2-1/2 to 4 parts aggregate.

2.4 PLASTER MATERIALS

- A. Portland Cement: ASTM C150/C150M, [**Type I**] [**Type II**].
 - 1. Color for Finish Coats: [**White**] [**Gray**].
- B. Masonry Cement: ASTM C91/C91M, Type N.
 - 1. Color for Finish Coats: [**White**] [**Gray**].
- C. Plastic Cement: ASTM C1328/C1328M.
- D. Colorants for Job-Mixed Finish Coats: Colorfast mineral pigments that produce finish plaster color [**to match Architect's sample**] <**Insert requirements**>.
- E. Lime: ASTM C206, Type S; or ASTM C207, Type S.
- F. Sand Aggregate: ASTM C897.
 - 1. Color for Job-Mixed Finish Coats: [**White**] [**In color matching Architect's sample**].

- G. Perlite Aggregate: ASTM C35.
- H. Exposed Aggregates for Finish Coats: **[For marblecrete finish, clean, sound, crushed marble matching color and size gradation of Architect's sample] <Insert requirements>.**

2.5 MISCELLANEOUS MATERIALS

- A. Water for Mixing and Finishing Plaster: Potable and free of substances capable of affecting plaster set or of damaging plaster, lath, or accessories.
- B. Fiber for Base Coat: Alkaline-resistant glass or polypropylene fibers, **1/2 inch** long, free of contaminants, manufactured for use in cement plaster.
- C. Bonding Compound: ASTM C932.
- D. Fasteners for Attaching Metal Lath to Substrates: ASTM C1063.
- E. Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, not less than **0.0475-inch** diameter unless otherwise indicated.
- F. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
 - 2. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.
- G. Acoustical Sealant: As specified in Section 079219 "Acoustical Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect adjacent work from soiling, spattering, moisture deterioration, and other harmful effects caused by plastering.
- B. Prepare smooth, solid substrates for plaster according to ASTM C926.

3.3 INSTALLATION, GENERAL

- A. Fire-Resistance-Rated Assemblies: Install components according to requirements for design designations from listing organization and publication indicated on Drawings.
- B. Sound-Attenuation Blankets: Where required, install blankets before installing lath unless blankets are readily installed after lath has been installed on one side.

3.4 APPLICATION OF BASE-COAT CEMENT PLASTER

- A. General: Comply with ASTM C926.

1. Do not deviate more than plus or minus **1/4 inch in 10 feet** from a true plane in finished plaster surfaces when measured by a **10-foot** straightedge placed on surface.
 2. Finish plaster flush with metal frames and other built-in metal items or accessories that act as a plaster ground unless otherwise indicated. Where casing bead does not terminate plaster at metal frame, cut base coat free from metal frame before plaster sets and groove finish coat at junctures with metal.
 3. Provide plaster surfaces that are ready to receive field-applied finishes indicated.
- B. Bonding Compound: Apply on **[unit masonry]** **[and]** **[concrete]** substrates for direct application of plaster.
- C. Walls; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork with **3/4-inch** total thickness, as follows:
1. Portland cement mixes.
 2. Masonry cement mixes.
 3. Portland and masonry cement mixes.
 4. Plastic cement mixes.
 5. Portland and plastic cement mixes.
- D. Ceilings; Base-Coat Mixes for Use over Metal Lath: For scratch and brown coats, for three-coat plasterwork and having **[1/2-inch total thickness]** **[3/4-inch total thickness for metal lath on concrete]**, as follows:
1. Portland cement mixes.
 2. Masonry cement mixes.
 3. Portland and masonry cement mixes.
 4. Plastic cement mixes.
 5. Portland and plastic cement mixes.
- E. Walls; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having **[3/8-inch thickness on masonry]** **[1/4-inch thickness on concrete]**, as follows:
1. Portland cement mix.
 2. Masonry cement mix.
 3. Portland and masonry cement mix.
 4. Plastic cement mix.
 5. Portland and plastic cement mix.
- F. Ceilings; Base-Coat Mix: For base (scratch) coat, for two-coat plasterwork and having **1/4-inch** thickness on concrete, as follows:
1. Portland cement mix.
 2. Masonry cement mix.
 3. Portland and masonry cement mix.
 4. Plastic cement mix.
 5. Portland and plastic cement mix.
- 3.5 REPAIR
- A. Repair or replace work to eliminate cracks, dents, blisters, buckles, crazing and check cracking, dry outs, efflorescence, sweat outs, and similar defects and where bond to substrate has failed.
- 3.6 CLEANING
- A. Remove temporary protection and enclosure of other work after plastering is complete.

- B. Promptly remove plaster from door frames, windows, and other surfaces not indicated to be plastered.
- C. Repair floors, walls, and other surfaces stained, marred, or otherwise damaged during plastering.

END OF SECTION 092400

SECTION 096613 - PORTLAND CEMENT TERRAZZO FLOORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Poured-in-place portland cement terrazzo flooring.
 - 2. Poured-in-place rustic terrazzo flooring.
 - 3. Precast terrazzo units.
- B. Related Requirements:
 - 1. Section 079200 "Joint Sealants" for sealants installed with terrazzo.

1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
 - 1. Review methods and procedures related to terrazzo including, but not limited to, the following:
 - a. Inspect and discuss condition of substrate and other preparatory work performed by other trades.
 - b. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - c. Review special terrazzo designs and patterns.
 - d. Review procedures for coping with unfavorable forecasted weather conditions.
 - e. <Insert agenda items>.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Data: For adhesives, indicating VOC content.
 - 3. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 4. Laboratory Test Reports: For sealers, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include terrazzo installation requirements. Include plans, sections, component details, and relationship to other work. Show layout of the following:
 - 1. Divider strips.
 - 2. Control-joint strips.
 - 3. Expansion-joint strips.
 - 4. Accessory strips.
 - 5. Abrasive strips.
 - 6. Stair treads, risers, and landings.
 - 7. Precast terrazzo jointing and edge configurations.
 - 8. Terrazzo patterns.
 - 9. <Insert requirements>.

- D. Samples: For each exposed product and for each color and texture specified, [**6 inches**] <Insert dimension> in size.
 - E. Samples for Initial Selection: NTMA's "Terrazzo Color Palette" showing the full range of colors and patterns available for each terrazzo type.
 - F. Samples for Verification: For each type, material, color, and pattern of terrazzo and accessory required showing the full range of color, texture, and pattern variations expected. Label each terrazzo Sample to identify manufacturer's matrix color and aggregate types, sizes, and proportions. Prepare Samples of same thickness and from same material to be used for the Work, in sizes indicated below:
 - 1. Terrazzo: [**6-inch-**] <Insert dimension> square Samples.
 - 2. Precast Terrazzo: [**6-inch-**] <Insert dimension> square Samples.
 - 3. Accessories: [**6-inch-**] <Insert dimension> long Samples of each exposed strip item required.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For Installer.
 - B. Material Certificates: For each type of terrazzo material or product.
- 1.5 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For terrazzo to include in maintenance manuals.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: An installer who is a contractor member of NTMA.
 - B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
 - 1. Build mockups for each type of terrazzo including accessories.
 - a. Size: Minimum **100 sq. ft.** of typical poured-in-place flooring condition for each color and pattern [**in locations indicated**] [**in locations directed by Architect**] <Insert location requirements>.
 - b. Include [**base**] [**first three stair treads**] <Insert item>.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials to Project site in supplier's original wrappings and containers, labeled with source's or manufacturer's name, material or product brand name, and lot number if any.
 - B. Store materials in their original, undamaged packages and containers, inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
- 1.8 FIELD CONDITIONS
- A. Environmental Limitations: Maintain interior ambient temperature above **50 deg F** for 48 hours before and during terrazzo installation.
 - B. Weather Limitations: Proceed with rustic terrazzo installation only when forecasted weather

conditions permit work to be performed according to NTMA's written recommendations and when temperatures remain above **45 deg F**.

- C. Field Measurements: Verify actual dimensions of construction contiguous with precast terrazzo by field measurements before fabrication.
- D. Provide permanent interior lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during terrazzo installation.
- E. Close spaces to traffic during terrazzo installation and for not less than 24 hours after installation unless manufacturer recommends a longer period.
- F. Control and collect water and dust produced by portland cement terrazzo grinding operations. Protect adjacent construction from detrimental effects of grinding operations.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Source Limitations for Aggregates: Obtain each color, grade, type, and variety of granular materials from single source with resources to provide materials of consistent quality in appearance and physical properties.

2.2 PERFORMANCE REQUIREMENTS

- A. NTMA Standards: Comply with NTMA's written recommendations for terrazzo type indicated unless more stringent requirements are specified.

2.3 PORTLAND CEMENT TERRAZZO

- A. Portland Cement Terrazzo System **<Insert designation>**: **[Sand cushion] [Bonded] [Monolithic]**.
 - 1. Underbed Thickness: **[As indicated on Drawings] <Insert dimension>**.
 - 2. Terrazzo Topping Thickness: **[As indicated on Drawings] <Insert dimension>**.
- B. Materials:
 - 1. Portland Cement: ASTM C150/C150M, Type 1.
 - a. Color for Terrazzo Matrix: **[As required by mix indicated] <Insert requirements>**.
 - 2. Water: Potable.
 - 3. Sand: ASTM C33/C33M.
 - 4. Aggregates: Comply with NTMA gradation standards for mix indicated and contain no deleterious or foreign matter.
 - a. Abrasion and Impact Resistance: Less than 40 percent loss per ASTM C131/C131M **[and ASTM C535 for large-size coarse aggregates]**.
 - b. 24-Hour Absorption Rate: Less than 0.75 percent.
 - c. Dust Content: Less than 1.0 percent by weight.
 - 5. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.
 - 6. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight, and compatible with terrazzo matrix.
 - 7. Underbed Bonding Agent: Neat portland cement paste.
 - 8. Topping Bonding Agent: Neat portland cement paste, or epoxy or acrylic bonding agents

formulated for use with monolithic terrazzo.

9. Underbed Reinforcement: Galvanized welded-wire reinforcement, wire **2 by 2 inches** by **0.062 inch** in diameter, complying with ASTM A1064/A1064M, except for minimum wire size.
10. Isolation Membrane: Polyethylene sheeting, ASTM D2103, Type 13300, **4 mils** thick; or unperforated asphalt felt, ASTM D226/D226M, Type I (No. 15).

C. Mixes:

1. Underbed Mix: One part portland cement to four parts sand and sufficient water to provide workability at as low a slump as possible.
2. Terrazzo Topping Mix: One **94-lb** bag of portland cement per [**200 lb**] **<Insert value>** of aggregate, matrix pigment if required by mix color, and sufficient water to produce a workable mix.
 - a. Mix Color and Pattern: [**As selected by Architect from NTMA's "Terrazzo Color Palette" CI Series**] [**As selected by Architect from NTMA's "Terrazzo Color Palette" CII Series**] [**As selected by Architect from NTMA's "Terrazzo Color Palette" CIII Series**] [**Match Architect's sample**] [**Match existing**] **<Insert NTMA designation or custom mix>**.

2.4 RUSTIC TERRAZZO

A. Rustic Terrazzo System **<Insert designation>**: [**Bonded**] [**Monolithic**].

1. Underbed Thickness: [**As indicated on Drawings**] **<Insert dimension>**.
2. Terrazzo Topping Thickness: [**As indicated on Drawings**] **<Insert dimension>**.

B. Materials:

1. Portland Cement: ASTM C150/C150M, Type 1.
 - a. Color for Terrazzo Matrix: [**As required by mix indicated**] **<Insert requirements>**.
2. Water: Potable.
3. Sand: ASTM C33/C33M.
4. Aggregates: As required for mix indicated, in sizes comply with NTMA gradation standards, with maximum 24-hour absorption rate of 0.25 percent, and containing no deleterious or foreign matter.
5. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.
6. Matrix Pigments: Pure mineral or synthetic pigments, alkali resistant, durable under exposure to sunlight and weather, and compatible with matrix binder.
7. Air-Entraining Admixture: ASTM C260/C260M.
8. Underbed Bonding Agent: Neat portland cement paste.
9. Topping Bonding Agent: Neat portland cement paste, or epoxy or acrylic bonding agents formulated for use with topping indicated.

C. Mixes:

1. Underbed Mix: One part portland cement to four parts sand and sufficient water to provide workability at as low a slump as possible and air entrainment agent to produce 6 percent plus or minus 1 percent air content at point of delivery.
2. Terrazzo Topping Mix: One **94-lb** bag of portland cement per [**200 lb**] **<Insert value>** of aggregate, matrix pigment if required by mix color, and sufficient water to produce a workable mix.
 - a. Mix Color and Pattern: [**As selected by Architect from NTMA's "Terrazzo**

Color Palette" CI Series] [As selected by Architect from NTMA's "Terrazzo Color Palette" CII Series] [As selected by Architect from NTMA's "Terrazzo Color Palette" CIII Series] [Match Architect's sample] [Match existing] <Insert NTMA designation or custom mix>.

2.5 STRIP MATERIALS

- A. Standard Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.
1. Material: [As indicated] [White-zinc alloy] [Brass] <Insert requirements>.
 2. Depth: [As indicated] [**3/4 inch**] [**1-1/4 inches**] [**2 inches**] <Insert dimension>.
 3. Width: [As indicated] [**0.05 inch**] [**1/8 inch**] [**1/4 inch**] <Insert dimension>.
- B. Heavy-Top Divider Strips: One-piece, flat-type strips for grouting into sawed joints prepared in substrate.
1. Base-Section Material: [As indicated] [White-zinc alloy] [Galvanized steel] <Insert requirements>.
 2. Top-Section Material: [As indicated] [White-zinc alloy] [Brass] [Plastic, in color selected from full range of industry colors] <Insert requirements>.
 3. Depth: [As indicated] [**3/4 inch**] [**1-1/4 inches**] [**2 inches**] <Insert dimension>.
 4. Top-Section Width: [As indicated] [**1/8 inch**] [**1/4 inch**] [**1/2 inch**] <Insert dimension>.
- C. Heavy-Top Angle Divider Strips: One-piece, L-type angle strips with anchoring device and in depth required for topping thickness indicated.
1. Material: [As indicated] [White-zinc alloy] [Brass] [Plastic, in color selected from full range of industry colors] <Insert requirements>.
 2. Top-Section Width: [As indicated] [**1/8 inch**] [**1/4 inch**] [**3/8 inch**] [**1/2 inch**] <Insert dimension>.
- D. Control-Joint Strips: Separate, double L-type angles, positioned back to back, that match material and color of divider strips and in depth required for topping thickness indicated.
- E. Expansion-Joint Strips: [Brass] [Plastic strips in color selected from full range of industry colors], with removable zip-strip top for installing sealant.
1. Width: [As indicated] [Minimum **1/2 inch**] <Insert dimension>.
- F. Accessory Strips: Match divider-strip width, material, and color unless otherwise indicated. Use the following types of accessory strips as required to provide a complete installation:
1. Base-bead strips for exposed top edge of terrazzo base.
 2. Edge-bead strips for exposed edges of terrazzo.
 3. Nosings for terrazzo stair treads and landings.
 4. <Insert requirements>.
- G. Abrasive Strips: [Three-line] [Two-line] [One-line] [Abrasive nosing strip and two-line] <Insert requirements> abrasive inserts at nosings. Silicon carbide or aluminum oxide, or combination of both, in epoxy-resin binder and set in channel.
1. Width: [**1/2 inch**] <Insert dimension>.
 2. Depth: As required by terrazzo thickness.
 3. Length: [**4 inches less than stair width**] [As indicated] <Insert dimension>.
 4. Color: [As selected by Architect from full range of industry colors] <Insert requirements>.

2.6 MISCELLANEOUS ACCESSORIES

- A. Strip Adhesive: Recommended by manufacturer for this use.
1. Adhesives shall have a VOC content of [70] <Insert value> g/L or less.
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- B. Anchoring Devices:
1. Strips: Provide mechanical anchoring devices or adhesives for strip materials as recommended by manufacturer and as required for secure attachment to substrate.
 2. Precast Terrazzo: Provide mechanical anchoring devices as recommended by fabricator for proper anchorage and support of units for conditions of installation and support.
- C. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.
- D. Isolation and Expansion-Joint Material: Closed-cell polyethylene foam, nonabsorbent to liquid water and gas, and non-outgassing in unruptured state; butyl rubber; rubber; or cork; [in width indicated] [minimum 1/2 inch wide] <Insert dimension>.
- E. Portland Cement Terrazzo Cleaner: Chemically neutral cleaner with pH factor between 7 and 10 that is biodegradable, phosphate free, and recommended by cleaner manufacturer for use on terrazzo type indicated.
- F. Rustic Terrazzo Cleaner: Solution of 1 part muriatic acid and 10 parts water.
- G. Sealer: Slip- and stain-resistant, penetrating-type sealer that is chemically neutral; does not affect terrazzo color or physical properties; is recommended by sealer manufacturer; and complies with NTMA's written recommendations for terrazzo type indicated.
1. Surface Friction: Not less than 0.6 according to ASTM D2047.

2. Acid-Base Properties: With pH factor between 7 and 10.
3. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
5. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 16.5 mcg/cu. m or 13.5 ppb, whichever is less.
6. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
7. Products shall comply with the requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
8. Rustic Terrazzo: Use solvent acrylic-type sealer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions, including levelness tolerances, have been corrected.

3.2 PREPARATION

- A. Clean substrates of substances, including oil, grease, and curing compounds, that might impair terrazzo bond. Provide clean, dry, and neutral substrate for terrazzo application.
 1. Roughen concrete substrates before installing terrazzo system according to NTMA's written recommendations.
- B. Protect other work from water and dust generated by grinding operations. Control water and dust to comply with environmental protection regulations.
 1. Erect and maintain temporary enclosures and other suitable methods to limit water damage and dust migration and to ensure adequate ambient temperatures and ventilation conditions during installation.

3.3 INSTALLATION, GENERAL

- A. Comply with NTMA's written recommendations for terrazzo and accessory installation.
- B. Installation Tolerance: Limit variation in terrazzo surface from level to [**1/4 inch in 10 feet**] **<Insert dimensions>**; noncumulative.
- C. Rustic Terrazzo: Install isolation and expansion material where abutting adjacent construction and directly above substrate expansion joints.
- D. Underbed:
 1. Comply with NTMA's written recommendations for underbed installation.

2. Sand-Cushion Portland Cement Terrazzo:
 - a. Cover entire surface to receive terrazzo with dusting of sand.
 - b. Install isolation membrane over sand, overlapping ends and edges a minimum of **3 inches**.
 - c. Install welded-wire reinforcement, overlapping at edges and ends at least two squares.[Stop mesh a minimum of **1 inch short of expansion joints.**]
 3. Bonded [**Portland Cement**] [**Rustic**] Terrazzo:
 - a. Saturate structural concrete substrate with water, and slush and broom with underbed bonding agent.
 4. Place underbed and screed to elevation indicated below finished floor elevation.
- E. Strip Materials:
1. Divider and Control-Joint Strips:
 - a. Locate divider strips [**directly over breaks and control joints in concrete slabs**] [**in locations indicated**] <Insert requirements>.
 - b. Install control-joint strips [**back to back and directly above concrete-slab control joints**] [**in locations indicated**] <Insert requirements>.
 - 1) Install control-joint strips with [**1/4-inch**] <Insert dimension> gap between strips, and install sealant in gap.
 - c. Install strips in adhesive setting bed without voids below strips, or mechanically anchor strips as required to attach strips to substrate, as recommended by strip manufacturer.
 2. Expansion-Joint Strips: Form expansion joints using divider strips and install directly above concrete-slab expansion joints.
 3. Accessory Strips: Install as required to provide a complete installation.
 4. Abrasive Strips: Install with surface of abrasive strip positioned [**1/16 inch**] <Insert dimension> higher than terrazzo surface.
- 3.4 POURED-IN-PLACE TERRAZZO INSTALLATION
- A. Underbed Preparation:
1. Sand-Cushion Portland Cement Terrazzo: Saturate underbed with water to produce a cement slurry.
 2. Bonded [**Portland Cement**] [**Rustic**] Terrazzo: Dampen underbed with water.
- B. Monolithic [**Portland Cement**] [**Rustic**] Terrazzo: Apply topping bonding agent on concrete substrate.
- C. Place terrazzo mixture in panels formed by divider strips and trowel mixture to top of strips. Seed additional aggregates in matrix to uniformly distribute granular material and produce a surface with a minimum of 70 percent aggregate exposure. Roll and compact surface until excess cement and water have been extracted.
1. Portland Cement Terrazzo: Trowel to a dense, uniform, flat surface disclosing lines of divider strips.
- D. Portland Cement Terrazzo Stairs: Install and finish stairs at the same time that adjacent flooring is installed.
- E. Portland Cement Terrazzo Base: Install and finish base at the same time that adjacent flooring is installed.

- F. Portland Cement Terrazzo Finishing: Cover terrazzo topping with moisture-retaining cover and cure until topping develops sufficient strength to prevent lifting or pulling of aggregate during grinding.
 - 1. Rough Grinding: Grind with 24-grit or finer stones or with comparable diamond plates.
 - 2. Grouting: After rough grinding, clean terrazzo topping with water and rinse away residue. Remove excess rinse water, apply matrix mix to grout surface, and fill voids. After grouting, cover surface with moisture-retaining cover to cure grout until ready for fine grinding.
 - 3. Fine Grinding and Polishing: Delay fine grinding until heavy trade work is complete and construction traffic through area is restricted. Grind with [80] [120]-grit stones or with comparable diamond abrasives until grout is removed from surface.
- G. Rustic Terrazzo Finishing: Expose aggregate by hosing or other means recommended in writing by NTMA. Cure the terrazzo topping by flooding with water or covering with moisture-retaining cover.

3.5 REPAIR

- A. Cut out and replace terrazzo areas that evidence lack of bond with substrate or underbed, including areas that emit a "hollow" sound if tapped. Cut out terrazzo areas in panels defined by strips and replace to match adjacent terrazzo, or repair panels according to NTMA's written recommendations, as approved by Architect.

3.6 CLEANING AND PROTECTION

- A. Terrazzo Cleaning:
 - 1. Remove grinding dust from installation and adjacent areas.
 - 2. Wash surfaces with cleaner immediately after final cleaning of terrazzo flooring according to both NTMA's and manufacturer's written recommendations and manufacturer's written instructions; rinse surfaces with water and allow them to dry thoroughly.
- B. Rustic Terrazzo Cleaning: Clean surfaces with rustic terrazzo cleaner. Legally contain and dispose of runoff from cleaning operations. Rinse surfaces with water and allow them to dry thoroughly.
- C. Sealing:
 - 1. Seal surfaces according to NTMA's written recommendations.
 - 2. Apply sealer according to sealer manufacturer's written instructions.
- D. Protection: Provide final protection and maintain conditions, in a manner acceptable to Installer, that ensure that terrazzo is without damage or deterioration at time of Substantial Completion.

END OF SECTION 096613

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include preparation requirements and application instructions.
2. Indicate VOC content.

B. Sustainable Design Submittals:

1. Product Data: For paints and coatings, indicating VOC content.
2. Environmental Product Declaration (EPD): For each product.
3. Health Product Declaration (HPD): For each product.
4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
5. Environmental Product Declaration (EPD): For each product.
6. Environmental Product Declaration (EPD): For each product.
7. Environmental Product Declaration (EPD): For each product.
8. Third-Party Certifications: For each product.
9. Third-Party Certified Life-Cycle Assessment: For each product.
10. Manufacturer Inventory: For each product, provide manufacturer's manifest of ingredients.

C. Samples: For each type of topcoat product.

D. Samples for Initial Selection: For each type of topcoat product.

E. Samples for Verification: For each type of paint system and each color and gloss of topcoat.

1. Submit Samples on rigid backing, **8 inches** square.
2. Apply coats on Samples in steps to show each coat required for system.
3. Label each coat of each Sample.
4. Label each Sample for location and application area.

F. Product Schedule: Use same designations indicated on Drawings and in the Exterior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint Products: **[5]** **<Insert number>** percent, but not less than **[1 gal.]** **<Insert value>** of each material and color applied.

1.4 QUALITY ASSURANCE

A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Architect will select one surface to represent surfaces and conditions for application of each paint system.

- a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft.**
 - b. Other Items: Architect will designate items or areas required.
2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 1. Concrete: 12 percent.
 2. Fiber-Cement Board: 12 percent.
 3. Masonry (Clay and Concrete Masonry Units): 12 percent.
 4. Wood: 15 percent.
 5. Portland Cement Plaster: 12 percent.
 6. Gypsum Board: 12 percent.
- C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- D. Exterior Gypsum Board Substrates: Verify that finishing compound is dry and sanded smooth.
- E. Verify suitability of substrates, including surface conditions and compatibility, with finishes and primers.
- F. Proceed with coating application only after unsatisfactory conditions have been corrected.
 1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems specified in this Section.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer[.][**but not less than the following:**]
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
 - 1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
 - 2. Sand surfaces that will be exposed to view, and remove sanding dust.
 - 3. Prime edges, ends, faces, undersides, and backsides of wood.
 - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Plastic Trim Fabrication Substrates: Remove dust, dirt, and other foreign material that might

impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints in accordance with manufacturer's written instructions.
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint **[both sides]** **[exterior side]** and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Paint entire exposed surface of window frames and sashes.
 - 5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 6. Primers specified in the Exterior Painting Schedule may be omitted on items that are factory primed or factory finished if compatible with intermediate and topcoat coatings and acceptable to intermediate and topcoat paint manufacturers.
- B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards **[and switch gear]**.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. **<Insert requirements>**.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written instructions, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written instructions.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from

Project site.

1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 3. Allow empty paint cans to dry before disposal.
 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System **<Insert drawing designation>**:
 - a. Prime Coat: **[Exterior, alkali-resistant, water-based primer] [Matching topcoat]**.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat] [low sheen] [semigloss] [gloss]**.
2. Latex over Latex Aggregate System **<Insert drawing designation>**:
 - a. Prime Coat: Textured latex coating, flat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat] [low sheen] [semigloss] [gloss]**.
3. Latex Aggregate System **<Insert drawing designation>**:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Textured latex coating, **[flat] [low sheen]**.
4. High-Build Latex System **<Insert drawing designation>**: Dry film thickness of not less than **10 mils**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Exterior, high-build latex paint.
5. Water-Based, Light Industrial Coating System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, **[low sheen] [semigloss] [gloss]**.

B. Concrete Substrates, Traffic Surfaces:

1. Latex Floor Paint System **<Insert drawing designation>**:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.

- c. Topcoat: Latex floor paint, low gloss.
 - 2. Latex Deck Coating System <Insert drawing designation>:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Latex deck coating.
 - 3. Alkyd Floor Enamel System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Alkyd floor enamel, gloss.
 - 4. Clear, Water-Based Sealer System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Water-based, concrete-floor sealer.
 - 5. Clear, Solvent-Based Sealer System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Solvent-based, concrete-floor sealer.
- C. Clay Masonry Substrates:
 - 1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 2. Latex Aggregate System <Insert drawing designation>:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Textured latex coating, [flat] [low sheen].
 - 3. High-Build Latex System <Insert drawing designation>: Dry film thickness of not less than **10 mils**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Exterior, high-build latex paint.
 - 4. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
- D. Concrete Masonry Unit Substrates:
 - 1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Exterior, latex block filler.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 2. Latex over Alkali-Resistant Primer System <Insert drawing designation>:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 3. Latex Aggregate System <Insert drawing designation>:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.

- b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Textured latex coating, [flat] [low sheen].
 - 4. High-Build Latex System <Insert drawing designation>: Dry film thickness of not less than **10 mils**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Exterior, high-build latex paint.
 - 5. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Exterior, latex block filler.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
- E. Steel and Iron Substrates:
 - 1. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: [Zinc-rich, inorganic primer] [Alkyd metal primer] [Epoxy metal primer] [Shop primer specified in Section in which substrate is specified].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 - 2. Water-Based, Light Industrial Coating over Epoxy System <Insert drawing designation>:
 - a. Prime Coat: Epoxy metal primer.
 - b. Intermediate Coat: High-build epoxy paint, low gloss.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 - 3. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd metal primer] [Surface-tolerant metal primer] [Shop primer specified in Section in which substrate is specified].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
 - 4. Quick-Drying Enamel System <Insert drawing designation>:
 - a. Prime Coat: Quick-drying, alkyd metal primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Quick-drying alkyd enamel, [semigloss] [gloss].
 - 5. Aluminum Paint System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd metal primer] [Shop primer specified in Section in which substrate is specified].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.
- F. Galvanized-Metal Substrates:
 - 1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Water-based, galvanized-metal primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 2. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: [Water-based, galvanized-metal primer] [Epoxy metal primer].
 - b. Intermediate Coat: Matching topcoat.

- c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
- G. Aluminum Substrates:
 - 1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Quick-drying aluminum primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 2. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Quick-drying aluminum primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 - 3. Alkyd System <Insert drawing designation>:
 - a. Pretreatment Coat: Vinyl wash primer.
 - b. Prime Coat: Quick-drying aluminum primer.
 - c. Intermediate Coat: Matching topcoat.
 - d. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
- H. Copper Substrates:
 - 1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Quick-drying aluminum primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 2. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Quick-drying aluminum primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 - 3. Alkyd System <Insert drawing designation>:
 - a. Pretreatment Coat: [Vinyl wash] [Quick-drying aluminum] primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
- I. Stainless Steel Substrates:
 - 1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 - 2. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Quick-drying aluminum primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 - 3. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Vinyl wash primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
- J. Glue-Laminated Wood Substrates:

1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 2. Latex over Alkyd/Oil Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 3. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, **[flat]** **[semigloss]** **[gloss]**.
- K. Exposed Wood-Framing Substrates:
1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 2. Latex over Alkyd Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 3. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, **[flat]** **[semigloss]** **[gloss]**.
- L. Dressed-Lumber Substrates: **[Trim]** **[Architectural woodwork]** **[Doors]** **[Windows]** **[Board siding]** **[Railings]** **[Fences]** <**Insert requirements**>.
1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 2. Latex over Alkyd Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 3. Water-Based, Light Industrial Coating System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, **[semigloss]** **[gloss]**.
 4. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, **[flat]** **[semigloss]** **[gloss]**.
- M. Wood Shingle and Shake Siding Substrates:
1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.

- c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 - 2. Latex over Alkyd Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 - 3. Alkyd System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, **[flat]** **[semigloss]** **[gloss]**.
- N. Wood-Based Panel Substrates:
 - 1. Latex over Latex Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 - 2. Latex over Alkyd Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, **[flat]** **[low sheen]** **[semigloss]** **[gloss]**.
 - 3. Alkyd System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, **[flat]** **[semigloss]** **[gloss]**.
- O. Wood-Board, Traffic-Surface Substrates:
 - 1. Latex Floor Paint over Latex Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Latex floor paint, low gloss.
 - 2. Latex Floor Paint over Alkyd Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Exterior, alkyd/oil wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Latex floor paint, low gloss.
 - 3. Latex Deck Coating System **<Insert drawing designation>**: For plywood decks.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommending in writing by topcoat manufacturer.
 - c. Topcoat: Latex deck coating.
 - 4. Alkyd Floor Enamel System **<Insert drawing designation>**:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Alkyd floor enamel, gloss.
 - 5. Alkyd Floor Enamel over Wood Preservative System **<Insert drawing designation>**:
 - a. Preservative Coat: Exterior wood preservative.
 - b. Prime Coat: Matching topcoat.
 - c. Intermediate Coat: Matching topcoat.
 - d. Topcoat: Alkyd floor enamel, gloss.
- P. Cementitious Composition Board Substrates: **[Siding]** **[Trim]** **[Panels]** **<Insert requirements>**.
 - 1. Latex System **<Insert drawing designation>**:

- a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 2. Latex over Alkyd Primer System <Insert drawing designation>:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 3. Alkyd System over Latex Wood Primer System <Insert drawing designation>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
 4. High-Build Latex System <Insert drawing designation>: Dry film thickness of not less than **10 mils**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Exterior, high-build latex paint.
 5. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 6. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
- Q. Fiberglass Substrates:
1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 2. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [low sheen] [semigloss] [gloss].
 3. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [flat] [semigloss] [gloss].
- R. Plastic-Trim-Fabrication Substrates:
1. Latex System <Insert drawing designation>:
 - a. Prime Coat: [Solvent] [Water]-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [flat] [low sheen] [semigloss] [gloss].
 2. Water-Based, Light Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: [Solvent] [Water]-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.

- c. Topcoat: Exterior, water-based, light industrial coating, [**low sheen**] [**semigloss**] [**gloss**].
 - 3. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [**flat**] [**semigloss**] [**gloss**].
- S. Portland Cement Plaster Substrates:
 - 1. Latex System <**Insert drawing designation**>:
 - a. Prime Coat: [**Matching topcoat**] [**Exterior, alkali-resistant, water-based primer**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [**flat**] [**low sheen**] [**semigloss**] [**gloss**].
 - 2. High-Build Latex System <**Insert drawing designation**>: Dry film thickness of not less than **10 mils**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Exterior, high-build latex paint.
 - 3. Water-Based, Light Industrial Coating System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [**low sheen**] [**semigloss**] [**gloss**].
- T. Exterior Gypsum Board Substrates:
 - 1. Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, latex wood primer, reduced in accordance with manufacturer's written instructions for substrate and topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [**flat**] [**low sheen**] [**semigloss**] [**gloss**].
 - 2. Latex Aggregate System <**Insert drawing designation**>:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Textured latex coating, [**flat**] [**low sheen**].
 - 3. High-Build Latex System <**Insert drawing designation**>: Dry film thickness of not less than **10 mils**.
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Exterior, high-build latex paint.
 - 4. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Exterior, latex wood primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [**flat**] [**semigloss**] [**gloss**].
- U. Exterior Canvas Substrates:
 - 1. Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [**flat**] [**low sheen**] [**semigloss**] [**gloss**].
 - 2. Water-Based, Light Industrial Coating System <**Insert drawing designation**>:

- a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior, water-based, light industrial coating, [**low sheen**] [**semigloss**] [**gloss**].
3. Alkyd System <**Insert drawing designation**>:
- a. Prime Coat: Exterior latex paint, flat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [**flat**] [**semigloss**] [**gloss**].
4. Aluminum Paint System <**Insert drawing designation**>:
- a. Prime Coat: Exterior latex paint, flat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.
- V. Bituminous-Coated Substrates:
1. Latex System <**Insert drawing designation**>:
- a. Prime Coat: Water-based, rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior latex paint, [**flat**] [**low sheen**] [**semigloss**] [**gloss**].
2. Latex Aggregate System <**Insert drawing designation**>:
- a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Textured latex coating, [**flat**] [**low sheen**].
3. Alkyd System <**Insert drawing designation**>:
- a. Prime Coat: Water-based, rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Exterior alkyd enamel, [**flat**] [**semigloss**] [**gloss**].
4. Aluminum Paint System <**Insert drawing designation**>:
- a. Prime Coat: Water-based, rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Water-based finish coatings.
 - 2. Solvent-based finish coatings.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
 - 1. Include preparation requirements and application instructions.
 - 2. Indicate VOC content.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
 - 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
 - 3. Environmental Product Declaration: For each product.
 - 4. Health Product Declaration: For each product.
 - 5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 - 6. Environmental Product Declaration: For each product.
 - 7. Environmental Product Declaration: For each product.
 - 8. Environmental Product Declaration: For each product.
 - 9. Third-Party Certifications: For each product.
 - 10. Third-Party Certified Life Cycle Assessment: For each product.
 - 11. Manufacturer Inventory: For each product, provide manufacturer's manifest of ingredients.
- C. Samples: For each type of topcoat product.
- D. Samples for Initial Selection: For each type of topcoat product.
- E. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, **8 inches** square.
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- F. Product Schedule: Use same designations indicated on Drawings and in the Interior Painting Schedule to cross-reference paint systems specified in this Section. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Paint Products: **[5]** **<Insert number>** percent, but not less than **[1 gal.]** **<Insert number>** of each material and color applied.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft.**
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - 1. Concrete: 12 percent.
 - 2. Fiber-Cement Board: 12 percent.
 - 3. Masonry (Clay and CMUs): 12 percent.
 - 4. Wood: 15 percent.
 - 5. Gypsum Board: 12 percent.
 - 6. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.

- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
 - F. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
 - G. Proceed with coating application only after unsatisfactory conditions have been corrected.
 - 1. Application of coating indicates acceptance of surfaces and conditions.
- 3.2 PREPARATION
- A. Comply with manufacturer's written instructions and recommendations applicable to substrates and paint systems indicated.
 - B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
 - C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
 - D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
 - F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer[.] [**but not less than the following:**]
 - 1. SSPC-SP 2.
 - 2. SSPC-SP 3.
 - 3. SSPC-SP 7/NACE No. 4.
 - 4. SSPC-SP 11.
 - G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
 - H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 - I. Aluminum Substrates: Remove loose surface oxidation.
 - J. Wood Substrates:
 - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.

2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 INSTALLATION

- A. Apply paints according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire-Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards[**and switch gear**].
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - i. **<Insert mechanical items to be painted>.**
 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.

- e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - i. **<Insert requirements>**.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry-Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry-film thickness.
- 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry-film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry-film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
 - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
 - 3. Allow empty paint cans to dry before disposal.
 - 4. Collect waste paint by type and deliver to recycling or collection facility.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

- A. Concrete Substrates, Nontraffic Surfaces:
- 1. Latex System **<Insert drawing designation>**:
 - a. Prime Coat: **[Alkali-resistant, water-based primer]** **[Matching topcoat]**.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior latex paint, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
 - 2. Latex over Latex Aggregate System **<Insert drawing designation>**:
 - a. Prime Coat: Textured latex coating, flat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior latex paint, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]**

- [gloss].
3. Latex Aggregate System <Insert drawing designation>:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Textured latex coating, [flat] [nonflat].
 4. Institutional Low-Odor/VOC Latex System <Insert drawing designation>:
 - a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 5. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Alkali-resistant, water based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 6. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
 7. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior alkyd, [flat] [eggshell] [semigloss] [gloss].
 8. Concrete Stain System <Insert drawing designation>:
 - a. First Coat: Matching topcoat.
 - b. Topcoat: Interior concrete stain.
- B. Concrete Substrates, Traffic Surfaces:
1. Latex Floor Enamel System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Latex floor paint, low gloss.
 2. Alkyd Floor Enamel System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Alkyd floor enamel, gloss.
 3. Concrete Stain System <Insert drawing designation>:
 - a. First Coat: Matching topcoat.
 - b. Topcoat: Interior concrete stain.
 4. Water-Based Concrete Floor Sealer System <Insert drawing designation>:
 - a. First Coat: Matching topcoat.
 - b. Topcoat: Water-based concrete floor sealer.
 5. Solvent-Based Concrete Floor Sealer System <Insert drawing designation>:
 - a. First Coat: Matching topcoat.
 - b. Topcoat: Solvent-based concrete floor sealer.
- C. Cement Board Substrates:
1. Latex System <Insert drawing designation>:

- a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
 2. Institutional Low-Odor/VOC Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
 3. High-Performance Architectural Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
 4. Water-Based Light-Industrial Coating System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, **[eggshell]** **[semigloss]** **[gloss]**.
 5. Alkyd System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
- D. Clay Masonry Substrates:
1. Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
 2. Latex Aggregate System **<Insert drawing designation>**:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Textured latex coating, **[flat]** **[nonflat]**.
 3. Institutional Low-Odor/VOC Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
 4. High-Performance Architectural Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, **[low sheen]** **[eggshell]** **[satin]** **[semigloss]**.
 5. Water-Based Light-Industrial Coating System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, **[eggshell]** **[semigloss]** **[gloss]**.
 6. Alkyd System **<Insert drawing designation>**:
 - a. Prime Coat: Alkali-resistant, water-based primer.

- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Interior, alkyd, **[flat]** **[eggshell]** **[semigloss]** **[gloss]**.

E. CMU Substrates:

1. Latex System **<Insert drawing designation>**:
 - a. Block Filler: Interior/exterior latex block filler.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
2. Latex Aggregate System **<Insert drawing designation>**:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Textured latex coating, **[flat]** **[nonflat]**.
3. Institutional Low-Odor/VOC Latex System **<Insert drawing designation>**:
 - a. Block Filler: Interior/exterior latex block filler.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
4. High-Performance Architectural Latex System **<Insert drawing designation>**:
 - a. Block Filler: Interior/exterior latex block filler.
 - b. Prime Coat: Alkali-resistant, water-based primer.
 - c. Intermediate Coat: Matching topcoat.
 - d. Topcoat: Interior, latex, high-performance architectural coating, **[low sheen]** **[eggshell]** **[satin]** **[semigloss]**.
5. Water-Based Light-Industrial Coating System **<Insert drawing designation>**:
 - a. Block Filler: Interior/exterior latex block filler.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, **[eggshell]** **[semigloss]** **[gloss]**.
6. Alkyd System **<Insert drawing designation>**:
 - a. Block Filler: Interior/exterior latex block filler.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, **[flat]** **[eggshell]** **[semigloss]** **[gloss]**.

F. Steel Substrates:

1. Latex System, Alkyd Primer **<Insert drawing designation>**:
 - a. Prime Coat: **[Alkyd quick-dry primer for metal]** **[Alkyd anticorrosive primer]** **[Shop primer specified in Section where substrate is specified]**.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
2. Latex over Shop-Applied Quick-Drying Shop Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Quick-dry primer for shop application.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.
3. Institutional Low-Odor/VOC Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Water-based rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, **[flat]** **[low sheen]** **[eggshell]** **[satin]** **[semigloss]** **[gloss]**.

4. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd quick-dry primer for metal] [Alkyd anticorrosive primer] [Shop primer specified in Section where substrate is specified].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
5. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Primer, rust-inhibitive, water based.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
6. Water-Based Light-Industrial Coating System over Epoxy Primer System <Insert drawing designation>:
 - a. Prime Coat: Anticorrosive epoxy primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
7. Water-Based Dry-Fall System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd quick-dry primer for metal] [Alkyd anticorrosive primer] [Shop primer specified in Section where substrate is specified].
 - b. Topcoat: [Dry fall, latex, flat] [Water-based dry fall for galvanized steel, flat] [Dry fall, latex, eggshell] [Dry fall, latex, semigloss].
8. Water-Based Dry Fall over Shop-Applied Quick-Drying Shop Primer System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for shop application.
 - b. Topcoat: [Dry fall, latex, flat] [Water-based dry fall for galvanized steel, flat] [Dry fall, latex, eggshell] [Dry fall, latex, semigloss].
9. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd quick-dry primer for metal] [Alkyd anticorrosive primer] [Shop primer specified in Section where substrate is specified].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
10. Alkyd over Surface-Tolerant Primer System <Insert drawing designation>:
 - a. Prime Coat: Surface-tolerant metal primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
11. Quick-Dry Enamel System <Insert drawing designation>:
 - a. Prime Coat: Alkyd quick-dry primer for metal.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
12. Alkyd Dry-Fall System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd quick-dry primer for metal] [Alkyd anticorrosive primer] [Shop primer specified in Section where substrate is specified].
 - b. Topcoat: Alkyd, dry fall, [flat] [eggshell] [semigloss].
13. Alkyd Dry Fall over Quick-Drying Primer System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for shop application.
 - b. Topcoat: Alkyd, dry fall, [flat] [eggshell] [semigloss].
14. Aluminum Paint System <Insert drawing designation>:
 - a. Prime Coat: [Alkyd quick-dry primer for metal] [Alkyd anticorrosive primer]

[Shop primer specified in Section where substrate is specified].

- b. Intermediate Coat: Matching topcoat.
- c. Topcoat: Aluminum paint.

G. Galvanized-Metal Substrates:

1. Latex System **<Insert drawing designation>**:
 - a. Prime Coat: **[Cementitious galvanized primer] [Water-based galvanized primer]**.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat] [low sheen] [eggshell] [satin] [semigloss] [gloss]**.
2. Institutional Low-Odor/VOC Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Water-based galvanized primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, **[flat] [low sheen] [eggshell] [satin] [semigloss] [gloss]**.
3. High-Performance Architectural Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Water-based galvanized primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, **[low sheen] [eggshell] [satin] [semigloss]**.
4. Water-Based Light-Industrial Coating System **<Insert drawing designation>**:
 - a. Prime Coat: Cementitious galvanized primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, **[eggshell] [semigloss] [gloss]**.
5. Water-Based Dry-Fall System **<Insert drawing designation>**:
 - a. Prime Coat: Matching topcoat.
 - b. Topcoat: Water-based dry fall for galvanized steel, flat.
6. Alkyd over Cementitious Primer System **<Insert drawing designation>**:
 - a. Prime Coat: Cementitious galvanized primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, **[flat] [eggshell] [semigloss] [gloss]**.
7. Alkyd Dry-Fall System (Cementitious Primer) **<Insert drawing designation>**:
 - a. Prime Coat: Cementitious galvanized primer.
 - b. Topcoat: Alkyd, dry fall, **[flat] [eggshell] [semigloss]**.
8. Aluminum Paint System **<Insert drawing designation>**:
 - a. Prime Coat: Cementitious galvanized primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.

H. Aluminum (Not Anodized or Otherwise Coated) Substrates:

1. Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, **[flat] [low sheen] [eggshell] [satin] [semigloss] [gloss]**.
2. Institutional Low-Odor/VOC Latex System **<Insert drawing designation>**:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, **[flat] [low sheen] [eggshell]**

- [satin] [semigloss] [gloss].
3. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 4. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
 5. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Primer, [Vinyl wash primer] [Quick-dry primer for aluminum].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
- I. Copper Substrates:
1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 2. Institutional Low-Odor/VOC Latex System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 3. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 4. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Quick-dry primer for aluminum.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating coating, [eggshell] [semigloss] [gloss].
 5. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Vinyl wash primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
- J. Stainless Steel Substrates:
1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 2. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.

- c. Topcoat: Interior, latex, high-performance architectural coating, [**low sheen**] [**eggshell**] [**satin**] [**semigloss**].
 - 3. Water-Based Light-Industrial Coating System <**Insert drawing designation**>:
 - a. Prime Coat: [**Solvent-based bonding primer**] [**Quick-dry primer for aluminum**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating coating, [**eggshell**] [**semigloss**] [**gloss**].
 - 4. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Vinyl wash primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [**flat**] [**eggshell**] [**semigloss**] [**gloss**].
- K. Exposed Wood Framing:
 - 1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 - 2. Latex over Alkyd Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 - 3. Institutional Low-Odor/VOC Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 - 4. High-Performance Architectural Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [**low sheen**] [**eggshell**] [**satin**] [**semigloss**].
 - 5. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [**flat**] [**eggshell**] [**semigloss**] [**gloss**].
- L. Finish Carpentry: [**Wood trim**] [**Doors**] [**Windows**] [**and**] [**Wood board paneling**].
 - 1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 - 2. Latex over Alkyd Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 - 3. Institutional Low-Odor/VOC Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.

- c. Topcoat: Interior, latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 - 4. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 - 5. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
 - 6. Water-Based Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Water-based alkyd, [gloss] [high gloss].
 - 7. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
- M. Architectural Woodwork: [Wood paneling] [and] [casework].
- 1. Latex over Latex Primer System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 - 2. Latex over Alkyd Primer System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 - 3. Institutional Low-Odor/VOC Latex System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 - 4. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 - 5. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
 - 6. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].

- N. Wood Traffic Surfaces: [**Floors**] [**and**] [**stairs**].
1. Latex Porch and Floor Enamel System <**Insert drawing designation**>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Latex floor paint, low gloss.
 2. Alkyd Floor Enamel System <**Insert drawing designation**>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Alkyd floor enamel, gloss.
- O. Wood Shingles and Shakes:
1. Latex over Latex Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer for wood.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 2. Latex over Alkyd Primer System <**Insert drawing designation**>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 3. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Interior, alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [**flat**] [**eggshell**] [**semigloss**] [**gloss**].
- P. Fiberglass Substrates:
1. Latex System <**Insert drawing designation**>:
 - a. Prime Coat: [**Water-based bonding primer**] [**Solvent-based bonding primer**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 2. Institutional Low-Odor/VOC Latex System <**Insert drawing designation**>:
 - a. Prime Coat: [**Water-based bonding primer**] [**Solvent-based bonding primer**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [**flat**] [**low sheen**] [**eggshell**] [**satin**] [**semigloss**] [**gloss**].
 3. High-Performance Architectural Latex System <**Insert drawing designation**>:
 - a. Prime Coat: [**Water-based bonding primer**] [**Solvent-based bonding primer**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [**low sheen**] [**eggshell**] [**satin**] [**semigloss**].
 4. Water-Based Light-Industrial Coating System <**Insert drawing designation**>:
 - a. Prime Coat: [**Water-based bonding primer**] [**Solvent-based bonding primer**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [**eggshell**] [**semigloss**] [**gloss**].
 5. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: [**Water-based bonding primer**] [**Solvent-based bonding primer**].
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [**flat**] [**eggshell**] [**semigloss**] [**gloss**].
- Q. Plastic Substrates:

1. Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 2. Institutional Low-Odor/VOC Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 3. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 4. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
 5. Alkyd System <Insert drawing designation>:
 - a. Prime Coat: Solvent-based bonding primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
- R. Spray-Textured Ceiling Substrates:
1. Latex, Flat System: Spray applied <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Topcoat: Interior, latex, flat.
 2. Latex System: Spray applied <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 3. Latex over Alkyd Sealer System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 4. Alkyd, Flat System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Topcoat: Interior, alkyd, flat.
 5. Alkyd over Alkyd Sealer System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
- S. [Gypsum Board] [and] [Plaster] Substrates:
1. Latex over Latex Sealer System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].

2. Latex over Alkyd Primer System (for Plaster Only) <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 3. Institutional Low-Odor/VOC Latex System <Insert drawing designation>:
 - a. Prime Coat: Interior, institutional low-odor/VOC primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 4. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 5. Water-Based Light-Industrial Coating System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, water-based, light-industrial coating, [eggshell] [semigloss] [gloss].
 6. Alkyd over Latex Sealer System <Insert drawing designation>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [flat] [eggshell] [semigloss] [gloss].
- T. Acoustic Panels and Tiles:
1. Latex, Flat System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Topcoat: Interior, latex, flat.
 2. Latex over Alkyd Sealer System <Insert drawing designation>:
 - a. Prime Coat: Interior alkyd primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 3. Institutional Low-Odor/VOC Latex System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [flat] [low sheen] [eggshell] [satin] [semigloss] [gloss].
 4. High-Performance Architectural Latex System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, high-performance architectural coating, [low sheen] [eggshell] [satin] [semigloss].
 5. Alkyd, Flat System <Insert drawing designation>:
 - a. Prime Coat: Matching topcoat.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, flat.
- U. [Cotton or Canvas] [and] [ASJ] Insulation-Covering Substrates: Including [pipe and duct coverings] <Insert description>.

1. Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satín**] [**semigloss**] [**gloss**].
 2. Institutional Low-Odor/VOC Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, institutional low odor/VOC, [**flat**] [**low sheen**] [**eggshell**] [**satín**] [**semigloss**] [**gloss**].
 3. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [**flat**] [**eggshell**] [**semigloss**] [**gloss**].
 4. Aluminum Paint System <**Insert drawing designation**>:
 - a. Prime Coat: Interior latex primer sealer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.
- V. Bituminous-Coated Substrates:
1. Latex System <**Insert drawing designation**>:
 - a. Prime Coat: Water-based rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, latex, [**flat**] [**low sheen**] [**eggshell**] [**satín**] [**semigloss**] [**gloss**].
 2. Alkyd System <**Insert drawing designation**>:
 - a. Prime Coat: Water-based rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Interior, alkyd, [**flat**] [**eggshell**] [**semigloss**] [**gloss**].
 3. Aluminum Paint System <**Insert drawing designation**>:
 - a. Prime Coat: Water-based rust-inhibitive primer.
 - b. Intermediate Coat: Matching topcoat.
 - c. Topcoat: Aluminum paint.

END OF SECTION 099123

SECTION 099653 - ELASTOMERIC COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of elastomeric coatings to the following exterior substrates:
 - 1. Concrete.
 - 2. Concrete unit masonry.
 - 3. Stucco.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 2. Indicate VOC content.
- B. Samples for Initial Selection: For each type of elastomeric coating.
- C. Samples for Verification: For each type of elastomeric coating indicated and in each color and gloss.
 - 1. Submit Samples on same type of substrate as that to receive application, **8 inches** square.
 - 2. Apply coats on Samples in steps to show each separate coat, including primers and block fillers as applicable.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.3 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional [**5**] **<Insert number>** percent but not less than [**1 gal.**] **<Insert quantity>** of each material, color, and texture applied.

1.4 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft.**
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations

in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F**.
 1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and ambient air temperatures are between **50 and 90 deg F** unless otherwise permitted by manufacturer's written instructions.
- B. Do not apply coatings in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.
- C. Allow wet surfaces to dry thoroughly and attain temperature and conditions specified before starting or continuing coating operation.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace elastomeric coatings that fail within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Water penetration through the coating.
 - b. Deterioration of coating beyond normal weathering.
 - c. **<Insert failure modes>**.
 2. Warranty Period: **[Five] [10] <Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Moisture-Vapor Transmission: Minimum **<Insert perms>**, based on testing according to ASTM D1653.
- C. Material Compatibility:
 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- D. Colors: **[As selected by Architect from manufacturer's full range] [Match Architect's samples] [As indicated in a color schedule] <Insert requirements>**.
 1. **[10] [20] [30] <Insert number>** percent of surface area will be painted with deep tones.
- E. Crack Fillers: Elastomeric coating manufacturer's recommended, factory-formulated crack

fillers or sealants, including crack filler primers, compatible with substrate and other materials indicated.

- F. Primer: Elastomeric coating manufacturer's recommended, factory-formulated, alkali-resistant primer compatible with substrate and other materials indicated.
- G. Concrete Unit Masonry Block Filler: Elastomeric coating manufacturer's recommended, factory-formulated, high-performance latex block filler compatible with substrate and other materials indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with manufacturer's requirements for maximum moisture content, alkalinity, and other conditions affecting performance of work.
- B. Begin coating only when moisture content of substrate is 12 percent or less when measured with an electronic moisture meter.
- C. Begin coating no sooner than [28] <Insert number> days after substrate is constructed and is visually dry on both sides.
- D. Verify that substrate is within the range of alkalinity recommended by manufacturer.
- E. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- F. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions[**and recommendations in the "MPI Architectural Painting Specification Manual"**] applicable to substrates and coating systems indicated.
- B. Remove hardware and hardware accessories, plates, machined surfaces, light fixtures, and similar items already installed that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, and incompatible paints and encapsulants. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 - 1. Remove incompatible primers and reprime substrate with compatible primers as required to produce coating systems indicated.
 - 2. Perform cleaning and coating application so dust and other contaminants from cleaning process will not fall on wet, newly coated surfaces.

- D. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.

3.3 APPLICATION

- A. Apply elastomeric coatings according to manufacturer's written instructions.
 - 1. Use equipment and techniques best suited for substrate and type of material being applied.
 - 2. Coat surfaces behind movable items the same as similar exposed surfaces.
 - 3. Apply each coat separately according to manufacturer's written instructions.
- B. Primers: Apply at a rate to ensure complete coverage.
- C. Block Fillers: Apply at a rate to ensure complete coverage with pores filled.
- D. Elastomeric Finish Coat(s): [Minimum two coats with a total dry film thickness of **16 to 18 mils**] [Minimum one coat with a total dry film thickness of **7 to 10 mils**] [**Manufacturer's recommended number of coats and total dry film thickness for condition of substrate**] **<Insert requirement>**.
- E. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats similar to color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- F. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform finish, color, and appearance.
- G. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- H. Apply coatings to prepared surfaces as soon as practicable after preparation and before subsequent surface soiling or deterioration.
- I. Spray Application: Use spray equipment for application only when permitted by authorities having jurisdiction. Wherever spray application is used, do not double back with spray equipment to build up film thickness of two coats in one pass.

3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following testing procedures:
 - 1. Owner will engage the services of a qualified testing agency to sample materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will perform tests for compliance of materials with product requirements.
 - 3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Remove noncomplying materials from Project site, pay for testing, and recoat surfaces that were coated with rejected materials. Remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.
- B. Field Testing and Inspection: Owner reserves the right to engage the services of a qualified

testing agency to verify installed thickness of elastomeric coatings.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities, touch up and restore damaged or defaced coated surfaces.

3.6 ELASTOMERIC COATING SCHEDULE

- A. Concrete Substrates:
 - 1. Elastomeric Coating System[**MPI EXT 3.1F**]:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat:
 - 1) Elastomeric, pigmented, exterior, water-based, flat coating[; **MPI #113**].
 - a) **<Insert manufacturer's name; product name or designation>**.
 - 2) Elastomeric, pigmented, exterior, water-based, nonflat coating[; **MPI #38**].
 - a) **<Insert manufacturer's name; product name or designation>**.
- B. Concrete Unit Masonry Substrates:
 - 1. Elastomeric Coating System[**MPI EXT 4.2D**]:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Block Filler: As recommended in writing by topcoat manufacturer.
 - c. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - d. Topcoat: Elastomeric, pigmented, exterior, water-based, flat coating[; **MPI #113**].
 - 1) **<Insert manufacturer's name; product name or designation>**.
- C. Stucco Substrates:
 - 1. Elastomeric Coating System[**MPI EXT 9.1C**]:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat:
 - 1) Elastomeric, pigmented, exterior, water-based, flat coating[; **MPI #113**].
 - a) **<Insert manufacturer's name; product name or designation>**.
 - 2) Elastomeric, pigmented, exterior, water-based, nonflat coating[; **MPI #38**].
 - a) **<Insert manufacturer's name; product name or designation>**.

END OF SECTION 099653

SECTION 099726 - CEMENTITIOUS COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes surface preparation and application of cementitious coating systems on the following substrates:
 - 1. Exterior concrete.
 - 2. Interior concrete masonry units.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For paints and coatings, indicating VOC content.
 - 2. Laboratory Test Reports: For paints and coatings, indicating compliance with requirements for low-emitting materials.
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: In each color and gloss of topcoat.
 - 1. Submit Samples on [**rigid backing**] [**actual substrate**], not less than **8 inches** square[, **with mortar joint in center**].
 - 2. Apply coats on Samples in steps to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.

1.3 INFORMATIONAL SUBMITTALS

- A. Material Certificates: For each cementitious coating, from manufacturer.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency or performed by a qualified testing agency, for each product formulation.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are from same production run (batch mix) as materials applied and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional [**5**] **<Insert number>** percent of each color applied.

1.5 QUALITY ASSURANCE

- A. Mockups: Apply mockups of coating system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one [**actual substrate of each type**] **<Insert requirements>** to represent surfaces and conditions for application of coating.
 - a. Wall Surfaces: Prepare Samples of at least [**100 sq. ft.**] **<Insert dimension>**.
 - 2. Apply mockups after permanent lighting and other environmental services have been activated.
 - 3. Final approval of color selections will be based on mockups.

- a. If preliminary color selections are not approved, apply additional mockups of colors selected by Architect at no added cost to Owner.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label, and the following information:
 - 1. Product name or title of material.
 - 2. Manufacturer's stock number and date of manufacture.
 - 3. Contents by volume, for pigment and vehicle constituents.
 - 4. Application instructions.
 - 5. Color name and number.
 - 6. Handling instructions and precautions.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of **45 deg F**. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
 - 1. Protect cementitious coating materials from freezing. Keep materials dry and storage area neat and orderly. Remove waste daily. Take necessary measures to ensure that workers and work areas are protected from health hazards resulting from handling, mixing, and applying the coating.

1.7 FIELD CONDITIONS

- A. Apply coatings only when temperature of surfaces to be painted and ambient air temperatures are between **50 and 95 deg F**.
- B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than **5 deg F** above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Verify suitability of substrates, including surface conditions and compatibility.
- C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
 - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for mixing and preparing materials and as applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that are not to be coated. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and coating.
 - 1. After completing coating operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances that could impair bond of coatings, including dirt, oil, grease, incompatible coatings, and loose substrate materials.
- D. Cementitious and Masonry Surfaces: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Crack Repair: Fill cracks according to manufacturer's written instructions before coating surfaces.
 - 1. Cracks Larger Than **1/32 Inch**: Cut out static cracks, voids, or honeycombing larger than **1/32 inch** and patch with materials recommended in writing by coating manufacturer. Identify dynamic cracks and treat according to manufacturer's written instructions before beginning application.

3.3 APPLICATION

- A. Apply coatings according to manufacturer's written instructions. Use applicators and techniques suited for coating and substrate indicated.
 - 1. Dampen substrate of surfaces to receive cementitious coatings one hour before beginning application to prevent surface drag. Immediately before applying coatings, redampen substrate. Substrates shall be saturated and surface dry at time of application.
 - 2. Brushes: Use Tampico or masonry brushes best suited for material being applied.
 - 3. Spray Equipment: Use spray equipment recommended in writing by manufacturer for material and texture required.
- B. Apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:
 - 1. First Coat: Apply polymer-modified cementitious coating material at the rate of **2 lb/sq. yd.** to achieve a total cured thickness of **25 mils.**
 - 2. Second Coat: Apply polymer-modified cementitious coating material at the rate of **1 lb/sq. yd.** to achieve a total cured thickness of **15 mils.**
 - 3. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.
- C. On previously coated surfaces, apply coating to achieve material thickness as recommended in writing by manufacturer, but not less than the following:
 - 1. Apply polymer-modified cementitious coating material at the rate of **1 lb/sq. yd.** to achieve a total cured thickness of **15 mils.**
 - 2. Apply additional coats when undercoats or other conditions show through final coat until cured film is of uniform coating finish, color, and appearance.
- D. Brush Application: Brush out and work brush coats into surfaces in an even film, filling all pores and voids at rate recommended in writing by manufacturer to achieve cured material thickness indicated. Finish coat with smooth, horizontal strokes.
- E. Spray Application: Apply each coat according to manufacturer's written instructions to provide the equivalent hiding of brush-applied coats. Follow spray application with a general light brooming of coated surface to impart a slight texture.

3.4 FIELD QUALITY CONTROL

- A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure at

any time and as often as Owner deems necessary during the period when coating operations are being conducted:

1. Owner will engage the services of a qualified testing agency to sample coating materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
2. Testing agency will perform tests for compliance with product requirements specified.
3. Owner may direct Contractor to stop coating application if test results show materials being used do not comply with requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from coating application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

3.6 CEMENTITIOUS COATING SCHEDULE

- A. Above-Grade Concrete and Masonry:
 1. Polymer-Modified Cementitious Coating:
 - a. Prime Coat: As recommended in writing by topcoat manufacturer.
 - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
 - c. Topcoat: Polymer-modified cementitious coating.
 - 1) **<Insert manufacturer's name; product name or designation>.**

END OF SECTION 099726

SECTION 101419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. Allowances for **[signage] [dimensional letter signs] [illuminated, fabricated channel dimensional characters]** **<Insert item description>** are specified in Section 012100 "Allowances."

- B. **<Insert product or material> [is] [are]** part of **<Insert name of allowance>**.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

- A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.5 COORDINATION

- A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

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

- B. Sustainable Design Submittals:

1. Product Data: For adhesives, indicating VOC content.
2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.

- C. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least **[half size]** **<Insert scale>**.
4. Show locations of electrical service connections.
5. Include diagrams for power, signal, and control wiring.

- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.

1. Include representative Samples of available typestyles and graphic symbols.

- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:

1. Dimensional Characters: **[Full-size Sample] [Half-size Sample]** **<Insert size>** of **[each type of]** dimensional character.
2. Exposed Accessories: **[Full-size Sample] [Half-size Sample]** **<Insert size>** of each

- accessory type.
- 3. Full-size Samples, if approved, will be returned to Contractor for use in the Project.
- F. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.
- G. Delegated Design Submittal: For **[signs indicated in "Performance Requirements" Article]** **<Insert sign designations>**.
 - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.7 INFORMATIONAL SUBMITTALS
 - A. Qualification Data: For **[Installer]** **[and]** **[manufacturer]**.
 - B. Sample Warranty: For special warranty.
- 1.8 CLOSEOUT SUBMITTALS
 - A. Maintenance Data: For signs to include in maintenance manuals.
- 1.9 QUALITY ASSURANCE
 - A. Installer Qualifications: **[Manufacturer of products]** **[An entity that employs installers and supervisors who are trained and approved by manufacturer]**.
- 1.10 FIELD CONDITIONS
 - A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.
- 1.11 WARRANTY
 - A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: **[Five]** **<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 sign structure and anchorage of **[rooftop]** **[dimensional character]** **<Insert description>** sign type(s) **<Insert drawing designation of sign(s)>** according to structural performance requirements.
 - B. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: **[As indicated on Drawings]** **<Insert design load>**.
 - 2. Concentrated Horizontal Load: **[As indicated on Drawings]** **<Insert design load>**.
 - 3. Other Design Load: **[As indicated on Drawings]** **<Insert design load>**
 - 4. Uniform and concentrated loads need not be assumed to act concurrently.

C. Thermal Movements: For exterior [**fabricated channel dimensional characters**] <Insert item>, allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [**120 deg F, ambient; 180 deg F, material surfaces**] <Insert temperature change>.

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

2.2 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Castings: ASTM B26/B26M, alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

B. Aluminum Sheet and Plate: **ASTM B209**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Aluminum Extrusions: **ASTM B221**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

D. Brass Castings: ASTM B584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C85200 (high-copper yellow brass)**] <Insert requirement>.

E. Brass Sheet (Yellow Brass): ASTM B36/B36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C26000 (yellow brass)**] <Insert requirement>.

F. Bronze Castings: ASTM B584, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C86500 (No. 1 manganese bronze)**] <Insert requirement>.

G. Bronze Plate: ASTM B36/B36M, [**alloy recommended by manufacturer and finisher for finish indicated**] [**lead-free alloy recommended by manufacturer and finisher for finish indicated**] [**Alloy UNS No. C22000 (commercial bronze)**] <Insert requirement>.

H. Copper Sheet: ASTM B152/B152M.

I. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, [**Type 304,**] [**Type 316,**] stretcher-leveled standard of flatness.

J. Zinc Castings: ASTM B240, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

K. Zinc Sheet: [**ASTM B69**] <Insert standard>, alloy and temper recommended by sign manufacturer for type of use and finish indicated.

L. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).

M. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and

exposure indicated.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
1. Use concealed fasteners and anchors unless indicated to be exposed.
 2. For exterior exposure, furnish **[nonferrous-metal] [stainless steel] [or] [hot-dip galvanized]** <Insert requirement> devices unless otherwise indicated.
 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - b. Fastener Heads: For nonstructural connections, use **[flathead] [or] [oval countersunk]** <Insert shape> screws and bolts with tamper-resistant **[Allen-head] [spanner-head] [or] [one-way-head]** <Insert slot design> slots unless otherwise indicated.
 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
1. Adhesives shall have a VOC content of **[70]** <Insert value> g/L or less.
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not

exceed 9 mcg/cu. m.

- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** thick, with adhesive on both sides.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
 - 7. Castings: Fabricate castings free of warp, cracks, blowholes, pits, scale, sand holes, and other defects that impair appearance or strength. Grind, wire brush, sandblast, and buff castings to remove seams, gate marks, casting flash, and other casting marks before finishing.
- B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish [**to match sign-background color**] [**to match Architect's sample**] <Insert requirement> color unless otherwise indicated.
 - 2. Stainless Steel Brackets: Factory finish brackets [**to match sign background**] [**to match Architect's sample**] [**with No. 4**] <Insert finish> finish unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.

- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [Class I, 0.018 mm] [Class II, 0.010 mm] or thicker.
- B. Color Anodic Finish: AAMA 611, [Class I, 0.018 mm] [Class II, 0.010 mm] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 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. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

2.8 LACQUER COATING FOR COPPER-ALLOY FINISHES

- A. Lacquer Coating: Clear, organic, waterborne, air-drying, acrylic lacquer called "Incralac"; specially developed for coating copper-alloy products; consisting of a solution of acrylic resin, methyl methacrylate copolymer, leveling agent, and corrosion inhibitor benzotriazole.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that electrical service is correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean

condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. Allowances for [**signage**] [**panel signs**] <Insert item description> are specified in Section 012100 "Allowances."
- B. <Insert product or material> [is] [are] part of <Insert name of allowance>.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.
- B. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.5 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

- A. Product Data:
 - 1. Panel signs.
 - 2. Field-applied, vinyl-character signs.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements[, **including raised characters and Braille**], and layout for each sign at least [**half size**] <Insert scale>.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.

- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Panel Signs: [**Full-size Sample**] [Not less than **12 inches square, including corner**] **<Insert size>**.
 - 2. Field-Applied, Vinyl-Character Signs: [**Full-size Sample of characters on glass**] **<Insert requirement>**.
 - 3. Variable Component Materials: [**Full-size Sample**] [**8-inch Sample**] **<Insert size>** of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 4. Exposed Accessories: [**Full-size Sample**] [**Half-size Sample**] **<Insert size>** of each accessory type.
 - 5. Full-size Samples, if approved, will be returned to Contractor for use in Project.
 - F. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.
 - G. Delegated Design Submittals: For [**signs indicated in "Performance Requirements" Article**] **<Insert sign designations>**.
 - 1. Include structural analysis calculations for signs indicated to comply with design loads; signed and sealed by the qualified professional engineer responsible for their preparation.
- 1.7 INFORMATIONAL SUBMITTALS
- A. Qualification Data: For [**Installer**] [**and**] [**manufacturer**].
 - B. Evaluation Reports: For [**post-installed anchors**] [**and**] [**power-actuated fasteners**], from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.
 - C. Sample Warranty: For special warranty.
- 1.8 CLOSEOUT SUBMITTALS
- A. Maintenance Data: For signs to include in maintenance manuals.
- 1.9 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Variable Component Materials: [**12**] **<Insert number>** replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
 - 2. Tools: [**One**] **<Insert number>** set(s) of specialty tools for assembling signs and replacing variable sign components.
- 1.10 QUALITY ASSURANCE
- A. Installer Qualifications: [**Manufacturer of products**] [**An entity that employs installers and supervisors who are trained and approved by manufacturer**].
- 1.11 FIELD CONDITIONS
- A. Field Measurements: Verify locations of [**anchorage devices**] [**and**] [**electrical service**] embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: **[Five]** <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 sign structure and anchorage of **[rooftop]** **[illuminated panel]** <Insert description> sign type(s) <Insert drawing designation of sign(s)> according to structural performance requirements.
- B. Structural Performance: Signs and supporting elements are to withstand the effects of gravity and other loads within limits and under conditions indicated.
 - 1. Uniform Wind Load: **[As indicated on Drawings]** <Insert design load>.
 - 2. Concentrated Horizontal Load: **[As indicated on Drawings]** <Insert dimension>.
 - 3. Other Design Load: **[As indicated on Drawings]** <Insert dimension>.
 - 4. Uniform and concentrated loads need not be assumed to act concurrently.
- C. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: **[120 deg F, ambient; 180 deg F, material surfaces]** <Insert temperature change>.
- D. 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>.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 PANEL-SIGN MATERIALS

- A. Aluminum Sheet and Plate: **ASTM B209**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: **ASTM B221**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Brass Sheet (Yellow Brass): ASTM B36/B36M, **[alloy recommended by manufacturer and finisher for finish indicated]** **[lead-free alloy recommended by manufacturer and finisher for finish indicated]** **[Alloy UNS No. C26000 (yellow brass)]** <Insert requirement>.
- D. Bronze Plate: ASTM B36/B36M, **[alloy recommended by manufacturer and finisher for finish indicated]** **[lead-free alloy recommended by manufacturer and finisher for finish indicated]** **[Alloy UNS No. C22000 (commercial bronze)]** <Insert requirement>.

- E. Copper Sheet: ASTM B152/B152M.
- F. Steel Materials:
 - 1. Metallic-Coated Steel Sheet: ASTM A653/A653M, [**G90**] <Insert coating designation> coating, either commercial or forming steel.
 - 2. Steel Sheet: [**Uncoated, cold-rolled, ASTM A1008/A1008M, commercial steel, Type B, exposed**] [or] [electrolytic zinc-coated, ASTM A879/A879M, Coating Designation **08Z**, with steel-sheet substrate according to ASTM A1008/A1008M, commercial steel, exposed].
 - 3. Steel Members Fabricated from Plate or Bar Stock: ASTM A529/A529M or ASTM A572/A572M, **42,000-psi** minimum yield strength.
 - 4. For steel exposed to view on completion, provide materials having flat, smooth surfaces without blemishes. Do not use materials whose surfaces exhibit pitting, seam marks, roller marks, rolled trade names, or roughness.
- G. Stainless Steel Sheet: ASTM A240/A240M or ASTM A666, [**Type 304**,] [**Type 316**,] stretcher-leveled standard of flatness.
- H. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- I. Fiberglass Sheet: 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.
- J. Polycarbonate Sheet: ASTM C1349, Appendix X1, Type II (coated, mar-resistant, UV-stabilized polycarbonate), with coating on both sides.
- K. PVC Sheet: Manufacturer's standard, UV-light stable, PVC plastic.
- L. Plastic-Laminate Sheet: ISO 4586-3, Grade HGS.
- M. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.
- N. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following unless otherwise indicated:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish [**nonferrous-metal**] [**stainless steel**] [or] [**hot-dip galvanized**] <Insert requirement> devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

- b. Fastener Heads: For nonstructural connections, use **[flathead]** **[or]** **[oval countersunk]** **<Insert shape>** screws and bolts with tamper-resistant **[Allen-head]** **[spanner-head]** **[or]** **[one-way-head]** **<Insert slot design>** slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
 - 5. Inserts: Furnish inserts to be set by other installers into concrete or masonry work.
- B. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on **[ICC-ES AC01]** **[ICC-ES AC193]** **[ICC-ES AC58]** **[or]** **[ICC-ES AC308]** as appropriate for the substrate.
 - 1. Uses: Securing signs with imposed loads to structure.
 - 2. Type: **[Torque-controlled, expansion anchor]** **[torque-controlled, adhesive anchor]** **[or]** **[adhesive anchor]**.
 - 3. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or **ASTM F1941**, Class Fe/Zn 5, unless otherwise indicated.
 - 4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy **[Group 1]** **[Group 2]** stainless steel bolts, **ASTM F593**, and nuts, **ASTM F594**.
- C. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Adhesive: As recommended by sign manufacturer.
 - 1. Adhesives shall have a VOC content of **[70]** **<Insert value>** g/L or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 - 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 6. Adhesive shall comply with the testing and product requirements of the California

Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

- E. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** thick, with adhesive on both sides.
- F. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.
- G. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.
- H. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 5. Internally brace signs for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
 - 6. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into indicated sign surface to produce precisely formed copy, incised to uniform depth.
 - 1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 - 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
 - 3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
 - 4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image is to be free of rough edges.
- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill

resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- F. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
 - 1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other device to assist in removing face sheet. Furnish initial changeable insert. **[Subsequent changeable inserts are by Owner] [Furnish two blank inserts for each sign for Owner's use] <Insert requirement>.**
 - 2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. **[Subsequent changeable inserts are by Owner] [Furnish two blank inserts for each sign for Owner's use] <Insert requirement>.**
 - 3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. **[Subsequent changeable sign panels are by Owner] <Insert requirement>.**
- G. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
 - 1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish **[to match sign-background color] [to match Architect's sample] <Insert requirement>** color unless otherwise indicated.
 - 2. Stainless Steel Brackets: Factory finish brackets **[to match sign background] [to match Architect's sample] [with No. 4] <Insert finish>** finish unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, **[Class I, 0.018 mm] [Class II, 0.010 mm]** or thicker.
- B. Color Anodic Finish: AAMA 611, **[Class I, 0.018 mm] [Class II, 0.010 mm]** or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion

coating, and applying and baking finish.

2.7 METALLIC-COATED STEEL FINISHES

- A. Surface Preparation: Clean surfaces of oil and other contaminants. Use cleaning methods that do not leave residue. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A780/A780M.
- B. Factory Prime Finish: After cleaning and pretreating, apply an air-dried primer compatible with the organic coating to be applied over it.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils**.

2.8 STEEL FINISHES

- A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, and prepare for coating according to coating manufacturer's written instructions.
 - 1. For Baked-Enamel or Powder-Coat Finish: After cleaning, apply a conversion coating compatible with the organic coating to be applied over it.
- B. Factory Prime Finish: After surface preparation and pretreatment, apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer.
- C. Baked-Enamel or Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to a minimum dry film thickness of **2 mils**.

2.9 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. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
 - 2. Directional Satin Finish: No. 4.
 - 3. Dull Satin Finish: No. 6.
 - 4. Reflective, Directional Polish: No. 7.
 - 5. Mirrorlike Reflective, Nondirectional Polish: No. 8.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchorage devices embedded in permanent construction are correctly sized and

located to accommodate signs.

- D. Verify that electrical service is correctly sized and located to accommodate signs.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
 - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Accessible Signage: Install in locations on walls [**as indicated on Drawings**] [**and**] [**according to the accessibility standard**] <Insert requirement>.
- C. Mounting Methods:
 - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
 - 2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
 - 3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
 - 4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
 - 5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive.

- Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
 7. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips [**0.250 inch**] <Insert dimension> away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
 8. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.
 9. Shim-Plate Mounting: Provide **1/8-inch-** thick, concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other direct mounting methods are impractical. Attach plate with fasteners and anchors suitable for secure attachment to substrate. Attach signs to plate using <Insert mounting method> method specified above.
- D. Field-Applied, Vinyl-Character Signs: Clean and dry substrate. Align sign characters in final position before removing release liner. Remove release liner in stages, and apply and firmly press characters into final position. Press from the middle outward to obtain good bond without blisters or fishmouths. Remove carrier film without disturbing applied vinyl film.
- E. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign and two-face tape.
- 3.3 ADJUSTING AND CLEANING
- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
 - B. Remove temporary protective coverings and strippable films as signs are installed.
 - C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.
- B. Related Requirements:
 - 1. Section 101300 "Directories" for building directories.
 - 2. Section 101416 "Plaques" for one-piece, solid metal signs, with or without frames, that are used for high-end room-identification.

1.2 ALLOWANCES

- A. Allowances for **[signage] [room-identification signs]** **<Insert item description>** are specified in Section 012100 "Allowances."
- B. **<Insert product or material> [is] [are]** part of **<Insert name of allowance>**.

1.3 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.5 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements[, **including raised characters and Braille**], and layout for each sign at least **[half size]** **<Insert scale>**.
- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.

- E. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
 - 1. Room-Identification Signs: **[Full-size Sample]** **<Insert size>**.
 - 2. Variable Component Materials: **[Full-size Sample]** **[8-inch Sample]** **<Insert size>** of each base material, character (letter, number, and graphic element) in each exposed color and finish not included in Samples above.
 - 3. Exposed Accessories: **[Full-size Sample]** **[Half-size Sample]** **<Insert size>** of each accessory type.
 - 4. Full-size Samples, if approved, will be returned to Contractor for use in Project.

- F. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For **[Installer]** **[and]** **[manufacturer]**.
- B. Sample Warranty: For special warranty.

1.8 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials[, **from the same product run,**] that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Variable Component Materials: **[12]** **<Insert number>** replaceable text inserts and interchangeable characters (letters, numbers, and graphic elements) of each type.
 - 2. Tools: **[One]** **<Insert number>** set(s) of specialty tools for assembling signs and replacing variable sign components.

1.10 QUALITY ASSURANCE

- A. Installer Qualifications: **[Manufacturer of products]** **[An entity that employs installers and supervisors who are trained and approved by manufacturer]**.

1.11 FIELD CONDITIONS

- A. Field Measurements: Verify locations of **[anchorage devices]** **[and]** **[electrical service]** embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: **[Five]** **<Insert number>** years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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>.

2.2 SIGN MATERIALS

- A. Aluminum Sheet and Plate: **ASTM B209**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: **ASTM B221**, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings[**and suitable for exterior applications**].
- E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish [nonferrous-metal] [stainless-steel] [or] [hot-dip galvanized] <Insert requirement> devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened sign unless otherwise indicated.
 - b. Fastener Heads: Use [flathead] [or] [oval countersunk] <Insert shape> screws and bolts with tamper-resistant [Allen-head] [spanner-head] [or] [one-way-head] <Insert slot design> slots unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly unless otherwise indicated.
 - b. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, and installed in predrilled holes.
- B. Adhesive: As recommended by sign manufacturer.
 - 1. Adhesives shall have a VOC content of [70] <Insert value> g/L or less.
 - 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

- Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, **0.045 inch** thick, with adhesive on both sides.
- D. Hook-and-Loop Tape: Manufacturer's standard two-part tape consisting of hooked part on sign back and looped side on mounting surface.
- E. Magnetic Tape: Manufacturer's standard magnetic tape with adhesive on one side.

2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- C. Subsurface-Etched Graphics: Reverse etch back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- D. Signs with Changeable Message Capability: Fabricate signs to allow insertion of changeable messages as follows:
1. For snap-in changeable inserts beneath removable face sheet, furnish one suction or other

device to assist in removing face sheet. Furnish initial changeable insert. [Subsequent changeable inserts are by Owner] [Furnish two blank inserts for each sign for Owner's use] <Insert requirement>.

2. For slide-in changeable inserts, fabricate slot without burrs or constrictions that inhibit function. Furnish initial changeable insert. [Subsequent changeable inserts are by Owner] [Furnish two blank inserts for each sign for Owner's use] <Insert requirement>.
3. For frame to hold changeable sign panel, fabricate frame without burrs or constrictions that inhibit function. Furnish initial sign panel. [Subsequent changeable sign panels are by Owner] <Insert requirement>.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, [Class I, 0.018 mm] [Class II, 0.010 mm] or thicker.
- B. Color Anodic Finish: AAMA 611, [Class I, 0.018 mm] [Class II, 0.010 mm] or thicker.
- C. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of **1.5 mils**. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls [as indicated on Drawings] [and] [according to the accessibility standard] <Insert requirement>.
- C. Mounting Methods:
 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

2. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
4. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
5. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips [**0.250 inch**] <Insert dimension> away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
6. Magnetic Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

**SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING
EQUIPMENT**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves without waterstop.
 - 2. Grout.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For sealants, indicating VOC content.
 - 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

1.3 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 SLEEVES WITHOUT WATERSTOP

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, hot-dip galvanized, with plain ends.
- C. Steel Sheet Sleeves: ASTM A653/A653M, **0.0239-inch** minimum thickness; hot-dip galvanized, round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.
- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: **5000 psi**, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES - GENERAL

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide [**1-inch**] <Insert dimension> annular clear space between piping and concrete slabs and walls.
 - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas [**2 inches**] <Insert dimension> above finished floor level.
 - 3. Using [**grout**] [or] [**silicone sealant**], seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - 2. Install sleeves that are large enough to provide **1/4-inch** annular clear space between sleeve and pipe or pipe insulation.
 - 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
 - 2. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

3.3 SLEEVE SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 - 1. Exterior Concrete Walls above and below Grade:
 - a. Sleeves with waterstops.
 - 1) Select sleeve size to allow for [**1-inch**] <Insert dimension> annular clear space between piping and sleeve for installing sleeve-seal system.
 - 2. Concrete Slabs-on-Grade:
 - a. Sleeves with waterstops.

- 1) Select sleeve size to allow for [**1-inch**] <Insert dimension> annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs above Grade:
 - a. [**Sleeves with waterstops**] [or] [**stack-sleeve fittings**].
4. Interior Partitions:
 - a. Sleeves without waterstops.

END OF SECTION 220517

SECTION 220523.13 - BUTTERFLY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer rubber.
- C. NBR: ABS, Buna-N, or nitrile butadiene rubber.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set butterfly valves closed or slightly open.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Domestic water piping specialties intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. ASME Compliance:
 - 1. ASME B16.1 for flanges on iron valves.
 - 2. ASME B16.5 for flanges on steel valves.
 - 3. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 4. ASME B31.9 for building services valves.
- C. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream piping unless otherwise indicated.
- F. Valve Actuator Types:
 - 1. Gear Actuator: For valves **NPS 8** and larger.
 - 2. Hand lever: For valves **NPS 6** and smaller.
 - 3. Chainwheel: Device for attachment to gear, handlever, or stem; of size and with chain for mounting height, according to "Installation of Valves" Article.
- G. Valves in Insulated Piping: Provide **2-inch** extended neck stems.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine mating flange faces for damage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- D. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Install chainwheels on actuators for butterfly valves [**NPS 4**] <Insert pipe size> and larger and more than [**96 inches**] <Insert dimension> above floor. Extend chains to [**60 inches**] <Insert dimension> above finished floor.
- G. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but

before final adjusting and balancing. If leakage cannot be repaired, replace valves.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - **150 PSIG** OR LESS

A. Pipe **NPS 2-1/2** and Larger:

1. Iron, Single-Flange (Lug-Type) Butterfly Valves: 200 CWP, NBR seat, and [**aluminum-bronze**] [**ductile-iron**] [**stainless steel**] disc.
2. Iron, Flangeless (Wafer-Type) Butterfly Valves: 200 CWP, NBR seat, and [**aluminum-bronze**] [**ductile-iron**] [**stainless steel**] disc.
3. Ductile-Iron, Grooved-End Butterfly Valves: [**175**] [**300**] CWP.

3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - **150 TO 200 PSIG**

A. Pipe **NPS 2-1/2** and Larger:

1. Iron, Single-Flange (Lug-Type) Butterfly Valves: 200 CWP, NBR seat, and [**aluminum-bronze**] [**ductile-iron**] [**stainless steel**] disc.
2. Iron, Flangeless (Wafer-Type) Butterfly Valves: 200 CWP, NBR seat, and [**aluminum-bronze**] [**ductile-iron**] [**stainless steel**] disc.
3. Ductile-Iron, Grooved-End Butterfly Valves: [**175**] [**300**] CWP.

3.6 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe **NPS 2-1/2** and Larger:

1. Iron, Single-Flange (Lug-Type) Butterfly Valves: 200 CWP, [**EPDM**] [**NBR**] seat, and [**aluminum-bronze**] [**ductile-iron**] [**stainless steel**] disc.
2. Iron, Flangeless (Wafer-Type) Butterfly Valves: 200 CWP, [**EPDM**] [**NBR**] seat, and [**aluminum-bronze**] [**ductile-iron**] [**stainless steel**] disc.
3. Ductile-Iron, Grooved-End Butterfly Valves: [**175**] [**300**] CWP.

B. CPVC Pipe [**NPS 2-1/2**] [**NPS 5**] and Larger: CPVC butterfly valve.

C. PVC Pipe [**NPS 2-1/2**] [**NPS 5**] and Larger: PVC butterfly valve.

D. Stainless Steel Pipe **NPS 2-1/2** and Larger: Stainless steel, grooved-end butterfly valve.

END OF SECTION 220523.13

SECTION 220523.14 - CHECK VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Bronze, swing check valves, press ends.

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene-diene terpolymer.
- C. NBR: Nitrile butadiene rubber (also known as Buna-N).

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Bronze, lift check valves.
 - 2. Bronze, swing check valves.
 - 3. Bronze, swing check valves, press ends.
 - 4. Iron, swing check valves.
 - 5. Iron, swing check valves with closure control.
 - 6. Iron, groove-end swing check valves.
 - 7. Iron, center-guided, spring-loaded check valves.
 - 8. Iron, plate-type check valves.
 - 9. CPVC ball check valves.
 - 10. PVC ball check valves.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, press connections, and weld ends.
 - 3. Set check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher-than-ambient-dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use stems or other components as lifting or rigging points unless specifically indicated for this purpose in manufacturer's instructions.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:
 - 1. Domestic water piping check valves intended to convey or dispense water for human

consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of authorities having jurisdiction, and NSF 61/NSF 372, or to be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:
 - 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.1 for flanges on iron valves.
 - 3. ASME B16.5 for flanges for metric standard piping.
 - 4. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 5. ASME B16.18 for cast-copper solder joint.
 - 6. ASME B16.22 for wrought copper solder joint.
 - 7. ASME B16.51 for press joint.
 - 8. ASME B31.9 for building services piping valves.
- C. AWWA Compliance: Comply with AWWA C606 for groove-end connections.
- D. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are unacceptable.
- E. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream piping unless otherwise indicated.
- G. Valve Bypass and Drain Connections: MSS SP-45.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Examine press fittings to verify they have been properly pressed.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

- B. Provide support of piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access and where not blocked by equipment, other piping, or building components.
- D. Install valves so that stems are horizontal or slope upward from centerline of pipe.
- E. Install valves in position that does not project into aisles or block access to other equipment.
- F. Install valves in position to allow full stem and manual operator movement.
- G. Verify that joints of each valve have been properly installed and sealed to assure there is no leakage or damage.
- H. Check Valves: Install check valves for proper direction of flow.
 - 1. Swing Check Valves: In horizontal position with hinge pin level.
 - 2. Check Valves: [**Center-guided type**] [**and**] [**plate type**], in horizontal or vertical position, between flanges.
 - 3. Lift Check Valves: With stem upright and plumb.
- I. Install valve tags. Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- J. Adhere to manufacturer's installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze, swing check valves with [**bronze**] [**or**] [**nonmetallic**] disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron, swing check valves with lever and weight or spring; or iron, center-guided, [**metal-seat**] [**or**] [**resilient-seat**] check valves.
 - c. NPS 2-1/2 (DN 65) and Larger for Sanitary Waste and Storm Drainage: Iron, swing check valves with lever and weight or spring.
- B. If valves with specified CWP ratings are unavailable, the same types of valves with higher CWP ratings may be substituted.
- C. End Connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded, soldered, or press-end connections.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flange or threaded.
 - 3. For Copper Tubing, **NPS 5** and Larger: Flange.

4. For Steel Piping, **NPS 2** and Smaller: Threaded.
 5. For Steel Piping, **NPS 2-1/2 to NPS 4**: Flange or threaded.
 6. For Steel Piping, **NPS 5** and Larger: Flange.
 7. For Groove End Tubing and Piping: Groove.
- 3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - 150 PSIG (1035 kPa) OR LESS
- A. Pipe NPS 2 (DN 50) and Smaller:
1. Vertical, Upflow Applications Only: Bronze, lift check valves with [**bronze**] [**nonmetallic**] disc, Class 125, with [**soldered**] [**or**] [**threaded**] end connections.
 2. Horizontal and Vertical Applications: Bronze, swing check valves with [**bronze**] [**nonmetallic**] disc, [**Class 125**] [**Class 150**], with [**soldered**] [**or**] [**threaded**] end connections.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron, swing check valves with [**metal**] [**nonmetallic-to-metal**] seats, [**Class 125**] [**Class 250**], with [**threaded**] [**or**] [**flange**] end connections.
 2. Iron, groove-end swing check valves, 300 CWP.
 3. Iron, dual-plate check valves with [**metal**] [**resilient**] seat, [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**], with [**threaded**] [**or**] [**flange**] end connections.
 4. Iron, single-plate check valves with resilient seat, [**Class 125**] [**Class 250**], with [**threaded**] [**or**] [**flange**] end connections.
- 3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - 150 TO 200 PSIG (1035 TO 1380 kPa)
- A. Pipe NPS 2 (DN 50) and Smaller:
1. Vertical, Upflow Applications Only: Bronze, lift check valves with [**bronze**] [**nonmetallic**] disc, Class 125, with [**soldered**] [**or**] [**threaded**] end connections.
 2. Horizontal and Vertical Applications: Bronze, swing check valves with [**bronze**] [**nonmetallic**] disc, [**Class 125**] [**Class 150**], with [**soldered**] [**or**] [**threaded**] end connections.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron, swing check valves with [**metal**] [**nonmetallic-to-metal**] seats, [**Class 125**] [**Class 250**], with [**threaded**] [**or**] [**flange**] end connections.
 2. Iron, groove-end swing check valves, 300 CWP, with [**threaded**] [**or**] [**flange**] end connections.
 3. Iron, dual-plate check valves with [**metal**] [**resilient**] seat, [**Class 125**] [**Class 150**] [**Class 250**] [**Class 300**], with [**threaded**] [**or**] [**flange**] end connections.
 4. Iron, single-plate check valves with resilient seat, [**Class 125**] [**Class 250**], with [**threaded**] [**or**] [**flange**] end connections.
- 3.7 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE
- A. Pipe NPS 2 (DN 50) and Smaller:
1. Bronze, swing check valves with [**bronze**] [**nonmetallic**] disc, [**Class 125**] [**Class 150**], with [**soldered**] [**or**] [**threaded**] end connections.
 2. Bronze, swing check valves with press-end connections.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron, swing check valves with [**metal**] [**nonmetallic-to-metal**] seats, [**Class 125**]

- [Class 250], with [threaded] [or] [flange] end connections.
- 2. Iron, swing check valves with closure control lever and [spring] [weight], Class 125, with [threaded] [or] [flange] end connections.
- 3. Iron, groove-end swing check valves, 300 CWP.
- 4. Iron, center-guided check valves with compact wafer, [Class 125] [Class 150] [Class 250] [Class 300].
- 5. Iron, center-guided check valves with [globe], [metal] [resilient] seat, [Class 125] [Class 150] [Class 250] [Class 300], with [threaded] [or] [flange] end connections.
- 6. Iron, dual-plate check valves with [metal] [resilient] seat, [Class 125] [Class 150] [Class 250] [Class 300], with [threaded] [or] [flange] end connections.
- 7. Iron, single-plate check valves with resilient seat, [Class 125] [Class 250], with [threaded] [or] [flange] end connections.
- C. CPVC Pipe, NPS 2 (DN 50) and Smaller: [Union] [Non-union] ball valve.
- D. CPVC Pipe, NPS 4 (DN 100) and Smaller: [Union] [Non-union] ball valve.
- E. PVC Pipe, NPS 2 (DN 50) and Smaller: [Union] [Non-union] ball valve.
- F. PVC Pipe, NPS 4 (DN 100) and Smaller: [Union] [Non-union] ball valve.

END OF SECTION 220523.14

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Metal pipe hangers and supports.
 2. Trapeze pipe hangers.
 3. Fiberglass pipe hangers.
 4. Pipe stands.
 5. Pipe-positioning systems.
 6. Equipment supports.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 3. Environmental Product Declaration (EPD): For each product.
 4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
 5. Environmental Product Declaration: For each product.
 6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
 7. Environmental Product Declaration: For each product.
 8. Environmental Product Declaration: For each product.
 9. Third-Party Certifications: For each product.
 10. Third-Party Certified Life Cycle Assessment: For each product.
- B. Shop Drawings: [**Signed and sealed by a qualified professional engineer.**] Show fabrication and installation details and include calculations for the following:
1. Trapeze pipe hangers.
 2. Metal framing systems.
 3. Fiberglass strut systems.
 4. Pipe stands.
 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Detail fabrication and assembly of trapeze hangers.
 2. Include design calculations for designing trapeze hangers.

1.3 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to [ASCE/SEI 7] **<Insert requirement>**.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
 - 3. Design seismic-restraint hangers and supports for piping and equipment[**and obtain approval from authorities having jurisdiction**].

2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
 - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**carbon steel**] [**stainless steel**] **<Insert material>**.
- B. Stainless-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**stainless steel**] **<Insert material>**.
- C. Copper Pipe and Tube Hangers:
 - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
 - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of [**copper-coated steel**] [**stainless steel**] **<Insert material>**.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.4 FIBERGLASS PIPE HANGERS

- A. Clevis-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 1 steel pipe hanger, except hanger is made of fiberglass or fiberglass-reinforced resin.
 - 2. Hanger Rods: Continuous-thread rod, washer, and nuts made of **[fiberglass]** **[polyurethane]** **[or]** **[stainless steel]** **<Insert material>**.
 - 3. Flammability: ASTM D635, ASTM E84, UL 94.
- B. Strap-Type, Fiberglass Pipe Hangers:
 - 1. Description: Similar to MSS SP-58, Type 9 or Type 10 steel pipe hanger, except hanger is made of fiberglass-reinforced resin.
 - a. Flammability: ASTM D635, ASTM E84, UL 94.
 - 2. Hanger Rod and Fittings: Continuous-thread rod, washer, and nuts made of **[stainless steel]** **<Insert material>**.

2.5 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
 - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.
 - 3. Hardware: Galvanized steel or polycarbonate.
 - 4. Accessories: Protection pads.
- C. Low-Profile, Single-Base, Single-Pipe Stand:
 - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
 - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
 - a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.
 - 3. Vertical Members: Two **[galvanized]** **[stainless]**-steel, continuous-thread, **1/2-inch** rods.
 - 4. Horizontal Member: Adjustable horizontal, **[galvanized]** **[stainless]**-steel pipe support channels.
 - 5. Pipe Supports: **[Roller]** **[Strut clamps]** **[Clevis hanger]** **[Swivel hanger]**.
 - 6. Hardware: **[Galvanized]** **[Stainless]** steel.
 - 7. Accessories: Protection pads.
 - 8. Height: **[12 inches above roof]** **<Insert lesser dimension above roof>**.
- D. High-Profile, Single-Base, Single-Pipe Stand:
 - 1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Single vulcanized rubber or molded polypropylene.
 - a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **<Insert value>** percent.
 - 3. Vertical Members: Two **[galvanized]** **[stainless]**-steel, continuous-thread, **1/2-inch** rods.

4. Horizontal Member: One adjustable-height, [galvanized-] [or] [stainless]-steel, pipe-support slotted channel or plate.
5. Pipe Supports: [Roller] [Clevis hanger] [Swivel hanger].
6. Hardware: [Galvanized] [Stainless] steel.
7. Accessories: Protection pads[, 1/2-inch, continuous-thread, galvanized-steel rod] [, 1/2-inch, continuous-thread, stainless-steel rod].
8. Height: [36 inches above roof] <Insert lesser dimension above roof>.

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; [vulcanized rubber] [molded polypropylene] <Insert material>.
 - a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert value> percent.
3. Vertical Members: Two or more, [galvanized] [stainless]-steel channels.
4. Horizontal Members: One or more, adjustable-height, [galvanized] [stainless]-steel pipe support.
5. Pipe Supports: [Roller] [Strut clamps] [Clevis hanger] [Swivel hanger].
6. Hardware: [Galvanized] [Stainless] steel.
7. Accessories: Protection pads[, 1/2-inch, continuous-thread rod].
8. Height: [36 inches above roof] <Insert lesser dimension above roof>.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.6 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

2.8 MATERIALS

- A. Aluminum: **ASTM B221**.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: **5000-psi**, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus **[200 lb]** <Insert value>.

3.2 INSTALLATION OF HANGER AND SUPPORT

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
 - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. **[Metal]** **[Fiberglass]** Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than **4 inches** thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts,

washers, and other accessories.

- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
 - K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
 - L. Install lateral bracing with pipe hangers and supports to prevent swaying.
 - M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, [**NPS 2-1/2**] <Insert size> and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
 - N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
 - O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
 - P. Insulated Piping:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 - 2. MSS SP-58, Type 39: Install protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.
 - 3. MSS SP-58, Type 40: Install protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4** and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. **NPS 1/4 to NPS 3-1/2: 12 inches** long and **0.048 inch** thick.
 - b. **NPS 4: 12 inches** long and **0.06 inch** thick.
 - c. **NPS 5 and NPS 6: 18 inches** long and **0.06 inch** thick.
 - d. **NPS 8 to NPS 14: 24 inches** long and **0.075 inch** thick.
 - e. **NPS 16 to NPS 24: 24 inches** long and **0.105 inch** thick.
 - 5. Pipes **NPS 8** and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 - 6. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.
- 3.3 INSTALLATION OF EQUIPMENT SUPPORTS
- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for **[trapeze pipe hangers]** **[and]** **[equipment supports]**.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to **[1-1/2 inches]** **<Insert dimension>**.

3.6 PAINTING

- A. Touchup:
 - 1. Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide a minimum dry film thickness of **2.0 mils**.
 - 2. Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in **[Section 099113 "Exterior Painting."]** **[Section 099123 "Interior Painting."]** **[Section 099600 "High-Performance Coatings."]**
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will

not have field-applied finishes.

- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel [**pipe hangers and supports**] [**metal trapeze pipe hangers**] [**and**] [**metal framing systems**] and attachments for general service applications.
- F. Use [**stainless-steel pipe hangers**] [**and**] [**fiberglass pipe hangers**] [**and**] [**fiberglass strut systems**] and [**stainless-steel**] [**or**] [**corrosion-resistant**] attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and [**copper**] [**or**] [**stainless-steel**] attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to **1050 deg F** pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.
 - 5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
 - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
 - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
 - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
 - 12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
 - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with

- steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction occurs.
 18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction occurs.
 19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24** if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30** if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to **6 inches** for heavy loads.
 2. Steel Clevises (MSS Type 14): For **120 to 450 deg F** piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For **120 to 450 deg F** piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): **750 lb.**
 - b. Medium (MSS Type 32): **1500 lb.**
 - c. Heavy (MSS Type 33): **3000 lb.**
 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
 3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use [**powder-actuated fasteners**] [**or**] [**mechanical-expansion anchors**] instead of building attachments where required in concrete construction.
- S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. TAB of domestic water system.
2. TAB of plumbing equipment:
 - a. Domestic water booster pumps.
 - b. Domestic hot-water in-line circulation pumps.
 - c. General-duty air compressors.
 - d. Sanitary sewage pumps.
 - e. Drainage pumps.
 - f. Laboratory air compressors.
 - g. Laboratory vacuum pumps.
3. Pipe-leakage test verification.
4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.3 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at [**Project site**] <**Insert location**> after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of [**14**] <**Insert number**> days' advance notice of scheduled meeting time and location.
 1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within [**30**] [**60**] [**90**] <**Insert number**> days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within [**30**] [**60**] [**90**] <**Insert number**> days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.

- C. Strategies and Procedures Plan: Within [30] [60] [90] <Insert number> days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within [30] [60] [90] <Insert number> days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by [NEBB] [or] [TABB]:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by [NEBB] [or] [TABB].
 - 2. TAB Technician: Employee of the TAB specialist and certified by [NEBB] [or] [TABB].
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's

operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, **[engage one of the following] [available TAB specialists that may be engaged include, but are not limited to, the following]:**

1. **<Insert TAB specialist's name>.**

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.

- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Domestic Water System:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
 - b. Water heaters are installed and functioning.
 - c. Piping is complete and all points of outlet are installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are clean.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves are 100 percent open.
 - i. **[Booster-] [and] [hot-water circulating]** pumps are operational and proper rotation is verified.
 - j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - k. Variable-frequency controllers' startup is complete and safeties are verified.
 - l. Suitable access to balancing devices and equipment is provided.
 - 2. Sanitary Sewage/Drainage System:
 - a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
 - b. Piping is complete.
 - c. Sanitary sewage pumps/drainage pumps are operational.
 - d. Control valves are functioning in accordance with the sequence of operation.
 - e. Shutoff valves are 100 percent open.
 - f. Suitable access to equipment is provided.
 - 3. Compressed-Air System:
 - a. Leakage and pressure tests on compressed air distribution system have been satisfactorily completed in accordance with Division 22 requirements.
 - b. Piping is complete and all points of outlet are installed.
 - c. Systems are flushed, filled, and air purged.
 - d. Strainers are clean.
 - e. Control valves are functioning in accordance with the sequence of operation.
 - f. Shutoff and balance valves are 100 percent open.
 - g. Compressors are operational and of proper rotation.
 - h. Gauge connections are installed directly at compressor inlet and outlet flanges prior

- to valves or strainers.
 - i. Variable-frequency controllers' startup is complete and safeties are verified.
 - j. Suitable access to balancing devices and equipment is provided,
 - 4. Vacuum System:
 - a. Leakage and pressure tests on vacuum system have been satisfactorily completed in accordance with Division 22 requirements.
 - b. Piping is complete and all points of inlet are installed.
 - c. Systems are flushed, filled, and purged.
 - d. Strainers are clean.
 - e. Control valves are functioning in accordance with the sequence of operation.
 - f. Shutoff and balance valves are 100 percent open.
 - g. Vacuum pumps are operational and of proper rotation.
 - h. Gauge connections are installed directly at vacuum pump inlet and outlet flanges prior to valves or strainers.
 - i. Variable-frequency controllers' startup is complete and safeties are verified.
 - j. Suitable access to balancing devices and equipment is provided.
- 3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING
- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in [AABC's "National Standards for Total System Balance"] [ASHRAE 111] [NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems"] and in this Section.
 - B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
 - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
 - C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
 - D. Take and report testing and balancing measurements in [**inch-pound (IP)**] [**and**] units.

3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
 - 1. Motors.
 - 2. Domestic water booster pumps.
 - 3. Domestic water in-line pumps.
 - 4. Domestic water heaters.
 - 5. Sanitary sewage pumps.
 - 6. Drainage pumps.
 - 7. Air compressors.
 - 8. Vacuum pumps.
 - 9. **<Insert equipment>**.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check expansion tank for proper setting.
 - 2. Check water heater for proper discharge temperature setting.
 - 3. Check remotest point of outlet for adequate pressure.
 - 4. Check flow-control valves for proper position.
 - 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 6. Verify that motor controllers are equipped with properly sized thermal protection.
 - 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR COMPRESSED-AIR SYSTEMS

- A. Prepare test reports for air compressors, and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare compressed-air systems for testing and balancing as follows:
 - 1. Check remotest point of outlet for adequate pressure.
 - 2. Check pressure-control valves for proper position.
 - 3. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 4. Verify that motor controllers are equipped with properly sized thermal protection.
- D. Measure and record upstream and downstream pressure of pressure-reducing valves.
- E. Check settings and operation of pressure-reducing valves. Record final settings.
- F. Check settings and operation of each safety valve. Record settings.

3.8 PROCEDURES FOR VACUUM SYSTEMS

- A. Prepare test reports for vacuum pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.

- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
 - C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
 - 1. Check remotest point of inlet for adequate vacuum.
 - 2. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 - 3. Verify that motor controllers are equipped with properly sized thermal protection.
- 3.9 PROCEDURES FOR DOMESTIC WATER SYSTEM BOOSTER PUMPS

- A. Adjust pumps to deliver total design flow.
 - 1. Measure total water flow.
 - a. Position valves for full flow through coils.
 - b. Measure flow by main flow meter, if installed.
 - c. If main flow meter is not installed, determine flow by pump TDH or known equipment pressure drop.
 - 2. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
 - e. With valves open, read pump TDH. Adjust pump discharge valve until design water flow is achieved. If excessive throttling is required to achieve desired flow, recommend pump impellers be trimmed to reduce excess throttling.
 - 3. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
- B. Adjust flow-measuring devices installed in mains and branches to design water flows.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- C. Verify final system conditions as follows:
 - 1. Re-measure and confirm that total water flow is within design.
 - 2. Re-measure final pumps' operating data, TDH, volts, amps, and static profile.
 - 3. Mark final settings.
- D. Verify that memory stops have been set.

3.10 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.

1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow, and verify that the pump has the intended impeller size.
2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
3. Mark final settings and verify that all memory stops have been set.
4. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings.

3.11 PROCEDURES FOR MOTORS

- A. Motors [1/2] <Insert value> HP and Larger: Test at final balanced conditions and record the following data:
 1. Manufacturer's name, model number, and serial number.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Phase and hertz.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter size and thermal-protection-element rating.
 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.12 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:
 1. Measure and record entering- and leaving-water temperatures.
 2. Measure and record water flow.
 3. Measure and record pressure drop.
 4. [Measure and]Record relief valve(s) pressure setting.
 5. Capacity: Calculate in **Btu/h** of heating output.
 6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
- B. Gas- and Oil-Fired Water Heaters:
 1. Measure and record entering- and leaving-water temperatures.
 2. Measure and record water flow.
 3. Measure and record pressure drop.
 4. [Measure and]Record relief valve(s) pressure setting.
 5. Capacity: Calculate in **Btu/h** of heating output.
 6. Fuel Consumption: If fuel supply is equipped with flow meter, measure and record consumption.

7. Efficiency: Calculate operating efficiency for comparison to submitted equipment.
8. Fan, motor, and motor controller operating data.

3.13 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
 1. Measure and record flows, temperatures, and pressures of each piece of equipment. Compare the values to design or nameplate information, where information is available.
 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
 3. Check the condition of filters.
 4. Check bearings and other lubricated parts for proper lubrication.
 5. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. TAB After Construction: Before performing testing and balancing of renovated existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished in accordance with renovation scope indicated by Contract Documents. Verify the following:
 1. New filters are installed.
 2. Bearings and other parts are properly lubricated.
 3. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
 1. Compare the indicated system flows of the renovated work to the measured flows, and determine the new pump speed.
 2. Verify that the indicated system flows of the renovated work result in velocities and pump speeds that are within the acceptable limits defined by equipment manufacturer.
 3. If calculations increase or decrease the system flow rates by more than [5] <Insert number> percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is [5] <Insert number> percent or less, equipment adjustments are not required.

3.14 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
 1. Domestic Water Flow Rate: [Plus or minus 5 percent] [Plus or minus 10 percent] [Plus 10 percent or minus 5 percent] <Insert value>. If design value is less than 10 gpm, within 10 percent.
 2. Compressed-Air Flow Rate: [Plus or minus 5 percent] [Plus or minus 10 percent] [Plus 10 percent or minus 5 percent] <Insert value>. If design value is less than 10 gpm, within 10 percent.
 3. Vacuum Flow Rate: [Plus or minus 5 percent] [Plus or minus 10 percent] [Plus 10 percent or minus 5 percent] <Insert value>.

3.15 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing

devices.

- B. Status Reports: Prepare [**weekly**] [**biweekly**] [**monthly**] <Insert time interval> progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.16 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
 - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Pump curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB specialist.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 - 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 12. Nomenclature sheets for each item of equipment.
 - 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 - 14. Test conditions for pump performance forms, including the following:
 - a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
 - 1. Flow rates.
 - 2. Pipe and valve sizes and locations.

3. Balancing stations.
 4. Position of balancing devices.
- E. Gas- and Oil-Fired Water Heaters Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Fuel type in input data.
 - g. Output capacity in **Btu/h.**
 - h. Ignition type.
 - i. Burner-control types.
 - j. Motor horsepower and speed.
 - k. Motor volts, phase, and hertz.
 - l. Motor full-load amperage and service factor.
 - m. Sheave make, size in **inches**, and bore.
 - n. Center-to-center dimensions of sheave and amount of adjustments in **inches.**
 2. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in **cfm.**
 - b. Entering-water temperature in **deg F.**
 - c. Leaving-water temperature in **deg F.**
 - d. Low-fire fuel input in **Btu/h.**
 - e. High-fire fuel input in **Btu/h.**
 - f. High-temperature-limit setting in **deg F.**
 - g. Operating set point in **Btu/h.**
 - h. Heating value of fuel in **Btu/h.**
- F. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Model number and unit size.
 - d. Manufacturer's serial number.
 - e. Output capacity in **Btu/h.**
 - f. Number of stages.
 - g. Connected volts, phase, and hertz.
 - h. Rated amperage.
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in **Btu/h.**
 - b. Entering-water temperature in **deg F.**
 - c. Leaving-water temperature in **deg F.**
 - d. High-temperature-limit setting in **deg F.**
 - e. Operating set point in **deg F.**
 - f. Voltage at each connection.
 - g. Amperage for each phase.

G. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model number and serial number.
 - f. Water flow rate in **gpm**.
 - g. Water-pressure differential in **feet of head or psig**.
 - h. Required net positive suction head in **feet of head or psig**.
 - i. Pump speed.
 - j. Impeller diameter in **inches**.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
2. Test Data (Indicated and Actual Values):
 - a. Static head in **feet of head or psig**.
 - b. Pump shutoff pressure in **feet of head or psig**.
 - c. Actual impeller size in **inches**.
 - d. Full-open flow rate in **gpm**.
 - e. Full-open pressure in **feet of head or psig**.
 - f. Final discharge pressure in **feet of head or psig**.
 - g. Final suction pressure in **feet of head or psig**.
 - h. Final total pressure in **feet of head or psig**.
 - i. Final water flow rate in **gpm**.
 - j. Voltage at each connection.
 - k. Amperage for each phase.

H. Instrument Calibration Reports:

1. Report Data:
 - a. Instrument type and make.
 - b. Serial number.
 - c. Application.
 - d. Dates of use.
 - e. Dates of calibration.

3.17 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of **[Architect] [Owner] [Construction Manager] [Commissioning Authority]**.
- B. **[Architect] [Owner] [Construction Manager] [Commissioning Authority]** shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either **[10] <Insert number>** percent of the total measurements recorded or the extent of measurements that can be accomplished in **[a normal 8-hour business day] <Insert value>**.

- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 - D. If the number of "FAILED" measurements is greater than [10] [20] <Insert number> percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
 - E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
 - F. Prepare test and inspection reports.
- 3.18 **ADDITIONAL TESTS**
- A. Within [90] <Insert number> days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Piping joining materials - domestic water.
 - 2. Encasement for piping.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Copper tube and fittings - domestic water.
 - 2. Ductile-iron pipe and fittings - domestic water.
 - 3. Galvanized-steel pipe and fittings - domestic water.
 - 4. Stainless steel piping and fittings - domestic water.
 - 5. CPVC piping - domestic water.
 - 6. PEX tube and fittings - domestic water.
 - 7. PEX-AL-PEX tube and fittings - domestic water.
 - 8. PEX-AL-HDPE tube and fittings - domestic water.
 - 9. PVC pipe and fittings - domestic water.
 - 10. Polypropylene (PP-R and PP-RCT) pipe and fittings - domestic water.
 - 11. Piping joining materials - domestic water.
 - 12. Encasement for piping.
 - 13. Transition fittings - domestic water.
 - 14. Dielectric fittings - domestic water.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
 - 3. Environmental Product Declaration: For each product.
 - 4. Health Product Declaration: For each product.
 - 5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 - 6. Environmental Product Declaration: For each product.
 - 7. Environmental Product Declaration: For each product.
 - 8. Environmental Product Declaration: For each product.
 - 9. Third-Party Certifications: For each product.
 - 10. Third-Party Certified Life Cycle Assessment: For each product.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installers of pressure-sealed joints are to be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe

couplings and fittings.

1.5 FIELD 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 in accordance with 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 interrupt water service without [**Architect's**] [**Construction Manager's**] [**Owner's**] written permission.

1.6 WARRANTY

- A. Polypropylene (PP-R and PP-RCT) Pipe and Fittings Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R and PP-RCT pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
 - 1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of piping system due to defects in materials or manufacturing.
 - 2. Warranty is to be in effect only upon submission by Contractor to manufacturer of valid pressure/leak documentation indicating that the system was tested and passed manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Domestic water piping, tubing, fittings, joints, and appurtenances intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act, with requirements of authorities having jurisdiction, and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PIPING MATERIALS

- A. Potable-water piping and components are to comply with NSF 14, NSF 61, and NSF 372. [**Include marking "NSF-pw" on piping.**]

2.3 PIPING JOINING MATERIALS - DOMESTIC WATER

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, **1/8 inch** thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. 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. Solder Filler Metals: ASTM B32, lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
1. Solvent cement shall have a VOC content of 490 g/L or less.
 2. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.
- G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.
1. Solvent cement shall have a VOC content of 510 g/L or less.
 2. Adhesive primer shall have a VOC content of 550 g/L or less.
 3. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 4. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 5. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
 6. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 7. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of

Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit, or 33 mcg/cu. m, and that of acetaldehyde shall not exceed 9 mcg/cu. m.

8. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
9. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
10. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." Formaldehyde emissions shall not exceed 9 mcg/cu. m or 7 ppb, whichever is less.
11. Adhesive primer shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers." The building concentration of formaldehyde shall not exceed half of the indoor recommended exposure limit or 33 mcg/cu. m and that of acetaldehyde shall not exceed 9 mcg/cu. m.

- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: **[Sheet]** **[or]** **[tube]**.
- C. Color: **[Black]** **[or]** **[natural]** **<Insert color>**.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 (DN 80) and smaller is to be the following:
 1. Annealed-temper copper tube, **[ASTM B88, Type K]** **[ASTM B88, Type L]**; **[wrought-copper, solder-joint fittings; and brazed]** **[copper pressure-seal fittings; and pressure-sealed]** joints.
 2. PVC, **[Schedule 40]** **[Schedule 80]**; socket fittings; and solvent-cemented joints.

3. Polypropylene (PP-R and PP-RCT), [SDR 7.4] [SDR 11] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 (DN 100 to DN 200) and larger is to be the following:
1. Annealed-temper copper tube, [ASTM B88, Type K] [ASTM B88, Type L]; wrought-copper, solder-joint fittings; and brazed joints.
 2. Mechanical-joint, ductile-iron pipe; [standard-] [or] [compact-]pattern, mechanical-joint fittings; and mechanical joints.
 3. Push-on joint, ductile-iron pipe; [standard-] [or] [compact-]pattern, push-on joint fittings; and gasketed joints.
 4. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
 5. PVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
 6. Polypropylene (PP-R and PP-RCT), [SDR 7.4] [SDR 11] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- F. Under-building-slab, combined domestic water, building-service, and fire-service-main piping, NPS 6 to NPS 12 (DN 150 to DN 300) is to be the following:
1. Mechanical-joint, ductile-iron pipe; [standard-] [or] [compact-]pattern, mechanical-joint fittings; and mechanical joints.
 2. Push-on joint, ductile-iron pipe; [standard-] [or] [compact-]pattern, push-on joint fittings; and gasketed joints.
 3. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
- G. Under-building-slab, domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
1. [Drawn-temper] [or] [annealed-temper] copper tube, ASTM B88, Type L; [wrought-copper, solder-joint fittings; and brazed] [copper pressure-seal-joint fittings; and pressure-sealed] joints.
 2. PVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
 3. Polypropylene (PP-R and PP-RCT), [SDR 7.4] [SDR 11] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- H. Aboveground domestic water piping, NPS 2 (DN 50) and smaller is to be the following:
1. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 2. Drawn-temper copper tube, [ASTM B88, Type L] [ASTM B88 Type M]; [cast-] [or] [wrought-]copper, solder-joint fittings; and [brazed] [soldered] joints.
 3. Drawn-temper copper tube, [ASTM B88, Type L] [ASTM B88 Type M]; copper pressure-seal-joint fittings; and pressure-sealed joints.
 4. Drawn-temper copper tube, [ASTM B88, Type L] [ASTM B88 Type M]; copper push-on joint fittings; and push-on joints.
 5. Stainless steel, [Schedule 5] [or] [Schedule 10] pipe; pressure-seal-joint fittings; and pressure-sealed joints.
 6. CPVC, [Schedule 40] [Schedule 80]; socket fittings; and solvent-cemented joints.
 7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 8. CPVC Tubing System: CPVC tube; CPVC socket fittings; and solvent-cemented joints. [NPS 1-1/2 and NPS 2 CPVC pipe with CPVC socket fittings may be used instead of tubing.]

9. PEX tube, **NPS 1** and smaller.
 - a. Fittings for PEX tube:
 - 1) ASTM F1807, metal insert and copper crimp rings.
 - 2) ASTM F1960, cold expansion fittings and reinforcing rings.
 - 3) ASSE 1061, push-fit fittings.
 10. PEX-AL-PEX tube, **NPS 1** and smaller; fittings for PEX-AL-PEX tube; and crimped joints.
 11. PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 12. Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- I. Aboveground domestic water piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100) is to be the following:
1. Drawn-temper copper tube, [**ASTM B88, Type LASTM B88 Type M**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.
 2. Drawn-temper copper tube, [**ASTM B88, Type LASTM B88 Type M**]; copper pressure-seal-joint fittings; and pressure-sealed joints.
 3. Drawn-temper copper tube, [**ASTM B88, Type LASTM B88 Type M**]; grooved-joint, copper-tube appurtenances; and grooved joints.
 4. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 5. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 6. Stainless steel, [**Schedule 5**] [**Schedule 10**] [**Schedule 40**] pipe; grooved-joint fittings, and grooved joints.
 7. CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 8. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 9. PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 10. Polypropylene (PP-R and PP-RCT), [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- J. Aboveground domestic water piping, NPS 5 to NPS 8 (DN 125 to DN 200), is to be the following:
1. Drawn-temper copper tube, [**ASTM B88, Type LASTM B88 Type M**]; [**cast-**] [**or**] [**wrought-**]copper, solder-joint fittings; and [**brazed**] [**soldered**] joints.
 2. Drawn-temper copper tube, [**ASTM B88, Type LASTM B88 Type M**]; grooved-joint, copper-tube appurtenances; and grooved joints.
 3. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 4. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 5. Stainless steel [**Schedule 5**] [**Schedule 10**] [**Schedule 40**] pipe, grooved-joint fittings, and grooved joints.
 6. CPVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 7. CPVC, Schedule 80 pipe; CPVC, Schedule 80 threaded fittings; and threaded joints.
 8. PVC, [**Schedule 40**] [**Schedule 80**]; socket fittings; and solvent-cemented joints.
 9. Polypropylene (PP-R and PP-RCT) [**SDR 7.4**] [**SDR 11**] pipe and socket fusion, butt fusion, fusion outlet, or electrofusion fittings and joints.
- K. Aboveground, combined domestic water-service and fire-service-main piping, NPS 6 to

NPS 12 (DN 150 to DN 300) is to be the following:

1. Plain-end, ductile-iron pipe; grooved-joint, ductile-iron-pipe appurtenances; and grooved joints.
2. Galvanized-steel pipe and nipples; galvanized, gray-iron threaded fittings; and threaded joints.
3. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
4. Stainless steel [**Schedule 5**] [**Schedule 10**] [**Schedule 40**] pipe, grooved-joint fittings, and grooved joints.

3.2 EARTHWORK

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

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab in accordance with CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints in accordance with AWWA C600 and AWWA M41.
- D. Install underground [**copper tube**] [**and**] [**ductile-iron pipe**] in PE encasement in accordance with ASTM A674 or AWWA C105/A21.5.
- E. Install valves in accordance with the following:
 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
 3. Section 220523.14 "Check Valves for Plumbing Piping."
 4. Section 220523.15 "Gate Valves for Plumbing Piping."
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level [**with 0.25 percent slope downward toward drain**] [**without pitch**] and plumb.
- H. Rough-in domestic water piping for water-meter installation in accordance with utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

- K. 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.
 - L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
 - M. Install piping to permit valve servicing.
 - N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
 - O. Install piping free of sags and bends.
 - P. Install fittings for changes in direction and branch connections.
 - Q. Install PEX tube with loop at each change of direction of more than 90 degrees.
 - R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
 - S. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gauges for Plumbing Piping."
 - T. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123.21 "Inline, Domestic Water Pumps."
 - U. Install thermometers on[**inlet and**] outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gauges for Plumbing Piping."
 - V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 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 pipes, tubes, and fittings before assembly.
 - C. Threaded Joints: Thread pipe with tapered pipe threads in accordance with 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.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings in accordance with ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube in accordance with ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints in accordance with AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints in accordance with AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints in accordance with AWWA C606. [**Square cut**] [**Roll**] groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts in accordance with ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 2. CPVC Piping: Join in accordance with ASTM D2846/D2846M.
 3. PVC Piping: Join in accordance with ASTM D2855.

- N. Joints for PEX Tubing, ASTM: Join in accordance with ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- O. Joints for PEX Tubing, ASSE: Join in accordance with ASSE 1061 for push-fit fittings.
- P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition **[fittings] [or] [unions]**.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric **[couplings] [couplings or nipples] [nipples] [unions]**.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric **[flanges] [flange kits] [nipples]**.
- D. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for **[copper] [ductile iron] [galvanized steel] [and] [stainless steel] [tube] [and] [pipe]**, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install vinyl-coated hangers for **[CPVC] [PVC] [and] [PP-R/PP-RCT]** pipe, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Install vinyl-coated hangers for PEX tube, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- F. Support horizontal piping within [**12 inches**] <Insert dimension> of each fitting.
- G. Support vertical runs of [**copper**] [**ductile iron**] [**galvanized steel**] [**and**] [**stainless steel**] [**tube**] [**and**] [**pipe**] to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- H. Support vertical runs of [**CPVC**] [**PVC**] [**and**] [**PP-R/PP-RCT**] pipe to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- I. Support vertical runs of PEX tube to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for **NPS 2-1/2** and larger.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
 - 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system in accordance with either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least **50 ppm** of chlorine. Isolate with valves and allow to stand for 24 hours.

- 2) Fill system or part thereof with water/chlorine solution with at least **200 ppm** of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
 - B. Clean non-potable domestic water piping as follows:
 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
 - C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
 - D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.
- 3.11 ADJUSTING
 - A. Perform the following adjustments before operation:
 1. Close drain valves, hydrants, and hose bibbs.
 2. Open shutoff valves to fully open position.
 3. Open throttling valves to proper setting.
 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 8. Check plumbing specialties and verify proper settings, adjustments, and operation.
- 3.12 FIELD QUALITY CONTROL
 - A. Tests and Inspections:
 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after installation and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance

- with requirements.
- c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
- d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Hydrostatic testing and documentation of test results for polypropylene (PP-R and PP-RCT) pipe to be in accordance with manufacturer's written instructions and submitted to manufacturer upon successful completion per warranty requirements.
 - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Specialty pipe fittings.
 - 2. Encasement for underground metal piping.

1.2 ACTION SUBMITTALS

- A. Product Data
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Galvanized-steel pipe and fittings.
 - 4. Stainless steel drainage pipe and fittings.
 - 5. Ductile-iron pipe and fittings.
 - 6. Copper tube and fittings.
 - 7. ABS pipe and fittings.
 - 8. PVC pipe and fittings.
 - 9. Specialty pipe fittings.
 - 10. Encasement for underground metal piping.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste 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 in accordance with requirements indicated:
 - 1. Notify [**Architect**] [**Construction Manager**] [**Owner**] no fewer than [**two**] <Insert **number**> days in advance of proposed interruption of sanitary waste service.
 - 2. Do not proceed with interruption of sanitary waste service without [**Architect's**]

[Construction Manager's] [Owner's] written permission.

1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: [10 ft. head of water] <Insert pressure>.
 - 2. Waste, Force-Main Piping: [50 psig] [100 psig] [150 psig] <Insert pressure>.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation to withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7] <Insert requirement>. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment":
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[and the unit will be fully operational after the seismic event]."
 - 2. Component Importance Factor: [1.5] [1.0].
- C. <Insert requirements for Component Amplification Factor and Component Response Modification Factor>.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: [Linear low-density polyethylene film of 0.008-inch] [or] [high-density, cross-laminated polyethylene film of 0.004-inch] minimum thickness.
- C. Form: [Sheet] [or] [tube].
- D. Color: [Black] [or] [natural] <Insert color>.

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.

2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 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 above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in [Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment"] [Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment"].
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 3. Do not change direction of flow more than 90 degrees.
 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 1. Building Sanitary Waste: Two percent downward in direction of flow for piping **NPS 3** and smaller; [1] [2] <Insert number> percent downward in direction of flow for piping

- NPS 4** and larger.
 - 2. Horizontal Sanitary Waste Piping: [**Two**] <Insert number> percent downward in direction of flow.
 - 3. Vent Piping: [**One**] <Insert number> percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
- 1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- O. Install steel piping in accordance with applicable plumbing code.
- P. Install stainless steel piping in accordance with ASME A112.3.1 and applicable plumbing code.
- Q. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- R. Install aboveground ABS piping in accordance with ASTM D2661.
- S. Install aboveground PVC piping in accordance with ASTM D2665.
- T. Install underground [**ABS**] [**and**] [**PVC**] piping in accordance with ASTM D2321.
- U. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- V. Install underground, ductile-iron, force-main piping according to AWWA C600.
 - 1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
 - 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 3. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- W. Install underground, copper, force-main tubing in accordance with CDA's "Copper Tube Handbook."
 - 1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- X. Install force mains at elevations indicated.
- Y. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.

- b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
 - Z. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - AA. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - BB. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - CC. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
 - C. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
 - D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
 - E. Join stainless steel pipe and fittings with gaskets in accordance with ASME A112.3.1.
 - F. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
 - G. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

- H. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- I. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
 - 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- J. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings [**5 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings [**4 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings [**5 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Waste Drainage Piping: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
 - 3. In Aboveground Force Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force Main Piping:
 - a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
 - b. NPS 2 (DN 50) and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric [**nipples**] [**unions**].
 - 3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric [**flanges**] [**flange kits**] [**nipples**].
 - 4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF VALVES

- A. General valve installation requirements for general-duty valve installation are specified in the following Sections:
 - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 - 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
 - 3. Section 220523.14 "Check Valves for Plumbing Piping."
 - 4. Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
 2. Install **[gate]** **[full-port ball]** valve for piping **NPS 2** and smaller.
 3. Install **[gate]** **<Insert type>** valve for piping **NPS 2-1/2** and larger.
- C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. **[Use normally closed type unless otherwise indicated.]**
 2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
 3. Install backwater valves in accessible locations.
 4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in **[Section 220529 "Hangers and Supports for Plumbing Piping and Equipment"]** **[Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment"]**.
1. Install **[carbon-steel]** **<Insert material>** pipe hangers for horizontal piping in noncorrosive environments.
 2. Install **[stainless steel]** **[fiberglass]** pipe hangers for horizontal piping in corrosive environments.
 3. Install **[carbon-steel]** **<Insert material>** pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft. (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. (30 m) if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. (30 m) or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for **[cast-iron]** **[steel]** **[stainless steel]** **[and]** **[copper]** soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for **[ABS]** **[and]** **[PVC]** piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within **12 inches** of each fitting[, **valve**,] and coupling.
- F. Support vertical runs of **[cast-iron]** **[steel]** **[stainless steel]** **[and]** **[copper]** soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction

requirements, whichever are most stringent.

- G. Support vertical runs of [**ABS**] [**and**] [**PVC**] piping to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves [**with cleanout cover flush with floor**] [**in pit with pit cover flush with floor**] <Insert description>.
 - 6. Comply with requirements for [**backwater valves**] [**cleanouts**] [**and**] [**drains**] specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections **NPS 2-1/2** and larger.
- D. Connect force-main piping to the following:
 - 1. Sanitary Sewer: To exterior force main.
 - 2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- F. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection

must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than **10 ft. head of water**.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of **1 inch wg**.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until

satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed Plastic Piping: Protect **[ABS]** **[PVC]** plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller are to be the following:
 1. Service cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings[**and hubless, single-stack aerator fittings**]; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless steel pipe and fittings, sealing rings, and gasketed joints.
 5. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 6. **[Solid-wall]** **[Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 7. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 8. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings [**and hubless, single-stack aerator fittings**]; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless steel pipe and fittings, sealing rings, and gasketed joints.
 5. **[Solid-wall]** **[Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: **[Unshielded]** **[Shielded]**, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 (DN 100) is to be the following:
 1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI]** **[heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Stainless steel pipe and fittings gaskets, and gasketed joints.
 5. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2 (DN 65 and DN 90): Hard copper tube, **Type M**; copper pressure fittings; and soldered joints.

6. **[Solid-wall] [Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 7. **[Solid-wall] [Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 8. Dissimilar Pipe-Material Couplings: **[Unshielded] [Shielded]**, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 (DN 125) and larger is to be the following:
1. Service cast iron, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI] [heavy-duty]** hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. **[Solid-wall] [Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: **[Unshielded] [Shielded]**, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 (DN 100) and smaller are to be the following:
1. **[Extra-heavy] [Service]** cast-iron soil piping; **[gaskets; and gasketed] [caulking materials; and caulked]** joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI] [heavy-duty] [cast-iron]** hubless-piping couplings; and coupled joints.
 3. Stainless steel pipe and fittings, gaskets, and gasketed joints.
 4. **[Solid-wall] [Cellular-core]** ABS pipe, ABS socket fittings, and solvent-cemented joints.
 5. **[Solid-wall] [Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: **[Unshielded] [Shielded]**, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 (DN 125) and larger are to be the following:
1. **[Extra-heavy] [Service]**, cast-iron soil piping; **[gaskets; and gasketed] [caulking materials; and caulked]** joints.
 2. Hubless, cast-iron soil pipe and fittings; **[CISPI] [heavy-duty] [cast-iron]** hubless-piping couplings; coupled joints.
 3. **[Solid-wall] [Cellular-core]** PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Dissimilar Pipe-Material Couplings: **[Unshielded] [Shielded]**, nonpressure transition couplings.
- H. Aboveground sanitary-sewage force mains NPS 1-1/2 and NPS 2 (DN 40 and DN 50) are to be the following:
1. Hard copper tube, **Type L**; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- I. Aboveground sanitary-sewage force mains NPS 2-1/2 to NPS 6 (DN 65 to DN 150) are to be the following:
1. Hard copper tube, **Type L**; copper pressure fittings; and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
- J. Underground sanitary-sewage force mains NPS 4 (DN 100) and smaller are to be the following:
1. **[Hard] [Soft]** copper tube, **Type L**; **[wrought-]**copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.

3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than **NPS 1-1/2** and pressure transition coupling for **NPS 1-1/2** and larger if dissimilar pipe materials.
- K. Underground sanitary-sewage force mains NPS 5 (DN 125) and larger are to be the following:
1. Hard copper tube, **Type L**; [**wrought**]-copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221316

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Specialty pipe and fittings.
 - 2. Encasement for underground metal piping.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For **[controlled-flow] [siphonic]** roof drainage system. Include calculations, plans, and details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail storm drainage piping. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Structural members to which drainage piping will be attached or suspended from.
- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

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

1.5 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage 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 storm drainage service.
 - 2. Do not proceed with interruption of storm drainage service without **[Architect's] [Construction Manager's] [Owner's]** written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: **[10-foot head of water] <Insert pressure>**.
 - 2. Storm Drainage, Force-Main Piping: **[50 psig] [100 psig] [150 psig] <Insert pressure>**.

2.2 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.

- B. Material: [High-density, crosslaminated polyethylene film of **0.004-inch**] [or] [linear low-density polyethylene film of **0.008-inch**] minimum thickness.
- C. Form: [Sheet] [or] [tube].
- D. Color: [Black] [or] [natural] <Insert color>.

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
 - 1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 - 2. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- 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 above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
 - 1. Do not change direction of flow more than 90 degrees.
 - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building piping beginning at low point of each system.

1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 3. Maintain swab in piping and pull past each joint as completed.
- M. Install piping at the following minimum slopes unless otherwise indicated:
1. Building Storm Drain: [2] <Insert number> percent downward in direction of flow for piping **NPS 3** and smaller; [1] [2] <Insert number> percent downward in direction of flow for piping **NPS 4** and larger.
 2. Horizontal Storm Drainage Piping: [2] <Insert number> percent downward in direction of flow.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
1. Install encasement on underground piping according to ASTM A674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
- Q. Install aboveground ABS piping according to ASTM D2661.
- R. Install aboveground PVC piping according to ASTM D2665.
- S. Install underground [**ABS**] [**and**] [**PVC**] piping according to ASTM D2321.
- T. Install engineered [**controlled-flow**] [**siphonic**] drain specialties and storm drainage piping in locations indicated.
- U. Install underground, ductile-iron, force-main piping according to AWWA C600.
1. Install buried piping inside building between wall and floor penetrations and connection to storm sewer piping outside building with restrained joints.
 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 3. Install encasement on piping according to ASTM A674 or AWWA C105/A 21.5.
- V. Install underground, copper, force-main tubing according to CDA's "Copper Tube Handbook."
1. Install encasement on piping according to ASTM A674 or AWWA C105/A 21.5.
- W. Install force mains at elevations indicated.
- X. Plumbing Specialties:
1. Install backwater valves in storm drainage gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in storm drainage

- force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 3. Install drains in storm drainage gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
 - Y. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - Z. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - AA. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - BB. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
 - C. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
 - D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
 - E. Join copper tube and fittings with soldered joints according to ASTM B828 procedure. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
 - F. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- H. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 appendices.
 - 3. PVC Piping: Join according to ASTM D2855 and ASTM D2665 appendices.
- I. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings [**5 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings [**4 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings [**5 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction and branch openings.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Drainage Piping: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
 - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force-Main Piping:
 - a. **NPS 1-1/2** and Smaller: Fitting-type transition couplings.
 - b. **NPS 2** and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
 - 2. Dielectric Fittings for [**NPS 2**] <Insert pipe size> and Smaller: Use dielectric [**nipples**] [**unions**].
 - 3. Dielectric Fittings for [**NPS 2-1/2 to NPS 4**] <Insert pipe size range>: Use dielectric [**flanges**] [**flange kits**] [**nipples**].
 - 4. Dielectric Fittings for [**NPS 5**] <Insert pipe size> and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements for general-duty valve installations are specified in the following Sections:
 - 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 - 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
 - 3. Section 220523.14 "Check Valves for Plumbing Piping."
 - 4. Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Shutoff Valves:

1. Install shutoff valve on each sump pump discharge.
 2. Install **[gate]** **[full port ball valve]** for piping **NS 2** and smaller.
 3. Install **[gate]** **<Insert type>** valve for piping **NPS 2-1/2** and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
1. Horizontal Piping: Horizontal backwater valves. **[Use normally closed type unless otherwise indicated.]**
 2. Install backwater valves in accessible locations.
 3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
- 3.6 INSTALLATION OF HANGERS AND SUPPORTS
- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
1. Install **[carbon-steel]** **<Insert material>** pipe hangers for horizontal piping in noncorrosive environments.
 2. Install **[stainless-steel]** **[fiberglass]** pipe hangers for horizontal piping in corrosive environments.
 3. Install **[carbon-steel]** **<Insert material>** pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. **100 Feet** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet** if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs **100 Feet** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install hangers for **[cast-iron]** **[galvanized steel]** **[ductile iron]** **[and]** **[copper]** soil **[tubing]** **[and]** **[piping]**, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for **[ABS]** **[and]** **[PVC]** piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within **12 inches** of each fitting[, valve,] and coupling.
- F. Support vertical **[cast-iron]** **[galvanized steel]** **[ductile iron]** **[and]** **[copper]** **[tubing]** **[and]** **[piping]** to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

- G. Support vertical **[ABS]** **[and]** **[PVC]** piping with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves **[with cleanout cover flush with floor]** **[in pit with pit cover flush with floor]** **<Insert description>**.
 - 3. Comply with requirements for **[backwater valves]** **[cleanouts]** **[and]** **[drains]** specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Connect force-main piping to the following:
 - 1. Storm Sewer: To exterior force main.
 - 2. Sump Pumps: To sump pump discharge.
- E. Where installing piping adjacent to equipment, allow space for service and maintenance.
- F. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 - 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage

- piping until it has been tested and approved.
- a. Expose work that was covered or concealed before it was tested.
- 3. Test Procedure:
 - a. Test storm drainage piping[, **except outside leaders,**] on completion of roughing-in.
 - b. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water**. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
- 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
- 5. Prepare reports for tests and required corrective action.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 - 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 - 2. Cap and subject piping to static-water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 - 4. Prepare reports for tests and required corrective action.
- D. Piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

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

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping [**NPS 6 and smaller**] <Insert pipe size range> shall be[**any of**] the following:
 - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPI,**] [**heavy-duty,**] hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 5. [**Solid-wall**] [**Cellular-core**] ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 6. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 7. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition

couplings.

- C. Aboveground, storm drainage piping [**NPS 8 and larger**] <Insert pipe size range> shall be[**any of**] the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 2. Hubless, cast-iron soil pipe and fittings; [**CISPI**], [**heavy-duty**], hubless-piping couplings; and coupled joints.
 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 5. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 6. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- D. Underground storm drainage piping [**NPS 6 and smaller**] <Insert pipe size range> shall be[**any of**] the following:
1. [**Extra Heavy**] [**Service**] class, cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**caulking materials; and caulked**] joints.
 2. Hubless, cast-iron soil pipe and fittings; [**CISPI**], [**heavy-duty**], [**cast-iron**], hubless-piping couplings; and coupled joints.
 3. [**Solid-wall**] [**Cellular-core**] ABS pipe, ABS socket fittings, and solvent-cemented joints.
 4. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- E. Underground, storm drainage piping [**NPS 8 and larger**] <Insert pipe size range> shall be[**any of**] the following:
1. [**Extra Heavy**] [**Service**] class, cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**caulking materials; and caulked**] joints.
 2. Hubless, cast-iron soil pipe and fittings; [**CISPI**], [**heavy-duty**], [**cast-iron**], hubless-piping couplings; and coupled joints.
 3. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 4. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-cemented joints.
 5. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- F. Aboveground storm drainage force mains [**NPS 1-1/2 and NPS 2**] <Insert pipe size range> shall be[**any of**] the following:
1. Hard copper tube, **Type L** copper pressure fittings, and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- G. Aboveground storm drainage force mains [**NPS 2-1/2 to NPS 6**] <Insert pipe size range> shall be[**any of**] the following:
1. Hard copper tube, **Type L** copper pressure fittings, and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 4. Fitting-type transition couplings if dissimilar pipe materials.
- H. Underground storm drainage force mains [**NPS 4 and smaller**] <Insert pipe size range> shall

be[**any of**] the following:

1. [Hard] [Soft] copper tube; **Type L** [wrought-]copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Fitting-type transition coupling for piping smaller than **NPS 1-1/2** and pressure transition coupling for **NPS 1-1/2** and larger if dissimilar pipe materials.
- I. Underground storm drainage force mains [**NPS 5 and larger**] <Insert pipe size range> shall be[**any of**] the following:
1. Hard copper tube; **Type L** [wrought-]copper pressure fittings; and soldered joints.
 2. Ductile-iron, mechanical-joint piping and mechanical joints.
 3. Ductile-iron, push-on-joint piping and push-on joints.
 4. Ductile-iron, grooved-joint piping and grooved joints.
 5. Pressure transition couplings if dissimilar pipe materials.

END OF SECTION 221413

SECTION 221414 - STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Specialty pipe fittings.
 - 2. Encasement for underground metal piping.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
 - 2. Hubless, cast-iron soil pipe and fittings.
 - 3. Galvanized-steel pipe and fittings.
 - 4. Copper tube and fittings.
 - 5. ABS pipe and fittings.
 - 6. PVC pipe and fittings.
 - 7. Specialty pipe fittings.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For controlled-flow roof drainage system. Include calculations, plans, sections, elevations, and details.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Detailed description of piping anchorage devices on which the certificate is based and their installation requirements.
- C. Field Quality-Control Reports: Inspection reports signed by authorities having jurisdiction.

1.4 QUALITY ASSURANCE

- A. Provide materials bearing label, stamp, or other markings of specified testing agency.

1.5 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage 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 storm drainage service.
 - 2. Do not proceed with interruption of storm drainage service without [**Architect's**]

[Construction Manager's] [Owner's] written permission.

1.6 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Storm Drainage Piping: **[10-foot head of water]** <Insert pressure>.
 2. Storm Drainage, Force-Main Piping: **[50 psig]** **[100 psig]** **[150 psig]** <Insert pressure>.
- B. Seismic Performance: Storm drainage piping and support and installation to withstand the effects of earthquake motions determined in accordance with **[ASCE/SEI 7]** <Insert requirement>. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully functional after the seismic event**]."
 2. Component Importance Factor: **[1.5]** **[1.0]**.
 3. <Insert requirements for Component Amplification Factor and Component Response Modification Factor>

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: [High-density, crosslaminated polyethylene film of **0.004-inch**] [or] [linear low-density polyethylene film of **0.008-inch**] minimum thickness.
- C. Form: **[Sheet]** [or] **[tube]**.
- D. Color: **[Black]** [or] **[natural]** <Insert color>.

PART 3 - EXECUTION

3.1 EARTH MOVING

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

3.2 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
- B. Install piping as indicated unless deviations from layout are approved on coordination drawings.

- C. Install piping in concealed locations.
 - 1. Piping installed in equipment rooms, service areas, and where indicated may be exposed.
- D. 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.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- L. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
 - 1. Do not change direction of flow more than 90 degrees.
 - 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of drainage piping in direction of flow is prohibited.
- M. Lay buried building piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- N. Install piping at the following minimum slopes unless otherwise indicated.
 - 1. Building Storm Drain: [**1/4 inch per foot**] <Insert number> downward in direction of flow for piping **NPS 3** and smaller; [**1/8 inch per foot**] [**1/4 inch per foot**] <Insert number> downward in direction of flow for piping **NPS 4** and larger.
 - 2. Horizontal Storm Drainage Piping: [**1/4 inch per foot**] <Insert number> downward in direction of flow.
- O. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Ch IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- P. Install steel piping in accordance with applicable plumbing code.
- Q. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."

- R. Install aboveground ABS piping in accordance with ASTM D2661.
 - S. Install aboveground PVC piping in accordance with ASTM D2665.
 - T. Install underground [**ABS**] [**and**] [**PVC**] piping in accordance with ASTM D2321.
 - U. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.
 - 1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
 - V. Install force mains at elevations indicated.
 - W. Plumbing Specialties:
 - 1. Install backwater valves in storm drainage gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
 - 2. Install cleanouts in storm drainage gravity-flow piping in accessible locations.
 - a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 3. Install drains in storm drainage gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
 - X. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
 - Y. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - Z. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
 - AA. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."
- 3.3 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
 - B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
 - C. Hubless, Cast-Iron Soil Piping Coupled Joints: Join in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 - 1. Cut threads full and clean using sharp dies.
 - 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry-seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- F. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- H. Plastic, Nonpressure-Piping, Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendices.
 - 3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendices.
- I. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings [**5 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings [**4 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings [**5 inches**] <Insert dimensions> and larger, upstream and downstream of all changes in direction and branch openings.

3.4 INSTALLATION OF SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Drainage Piping: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
 - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for **[NPS 2]** <Insert pipe size> and Smaller: Use dielectric **[nipples]** **[unions]**.
3. Dielectric Fittings for **[NPS 2-1/2 to NPS 4]** <Insert pipe size range>: Use dielectric **[flanges]** **[flange kits]** **[nipples]**.
4. Dielectric Fittings for **[NPS 5]** <Insert pipe size> and Larger: Use dielectric flange kits.

3.5 INSTALLATION OF VALVES.

- A. General valve installation requirements for general-duty valve installations are specified in the following Sections:
 1. Section 220523.12 "Ball Valves for Plumbing Piping."
 2. Section 220523.13 "Butterfly Valves for Plumbing Piping."
 3. Section 220523.14 "Check Valves for Plumbing Piping."
 4. Section 220523.15 "Gate Valves for Plumbing Piping."
- B. Shutoff Valves:
 1. Install shutoff valve on each sump pump discharge.
 2. Install **[gate]** **[full port ball valve]** for piping **NS 2** and smaller.
 3. Install **[gate]** **[butterfly]** <Insert type> valve for piping **NPS 2-1/2** and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 1. Horizontal Piping: Horizontal backwater valves. **[Use normally closed type unless otherwise indicated.]**
 2. Install backwater valves in accessible locations.
 3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install **[carbon-steel]** <Insert material> pipe hangers for horizontal piping in noncorrosive environments.
 2. Install **[stainless steel]** **[fiberglass]** pipe hangers for horizontal piping in corrosive environments.
 3. Install **[carbon-steel]** <Insert material> pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. **100 Feet** and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than **100 Feet**: MSS Type 43, adjustable roller hangers.
 - c. Longer Than **100 Feet** if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs **100 Feet** or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Install hangers for [**cast-iron**] [**galvanized-steel**] [**and**] [**copper**] soil [**tubing**] [**and**] [**piping**], with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Install hangers for [**ABS**] [**and**] [**PVC**] piping, with maximum horizontal spacing and minimum rod diameters, to comply with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- E. Support horizontal piping and tubing within **12 inches** of each fitting[, **valve**,] and coupling.
- F. Support vertical [**cast-iron**] [**galvanized steel**] [**and**] [**copper**] [**tubing**] [**and**] [**piping**] to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.
- G. Support vertical [**ABS**] [**and**] [**PVC**] piping with manufacturer's written instructions, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves [**with cleanout cover flush with floor**] [**in pit with pit cover flush with floor**] <Insert description>.
 - 3. Comply with requirements for [**backwater valves**] [**cleanouts**] [**and**] [**drains**] specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
- E. Make connections in accordance with the following unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2** and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 - B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
 - C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - D. Test storm drainage piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Test Procedure:
 - a. Test storm drainage piping[, **except outside leaders,**] on completion of roughing-in.
 - b. Close openings in piping system and fill with water to point of overflow, but not less than **10-foot head of water**.
 - c. From 15 minutes before inspection starts until completion of inspection, water level must not drop.
 - d. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
 - E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of **50 psig** above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.
- 3.10 CLEANING
- A. Clean interior of piping. Remove dirt and debris as work progresses.
- 3.11 PROTECTION
- A. Protect piping and drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- B. Place plugs in ends of uncompleted piping at end of day and when work stops.
- C. Repair damage to adjacent materials caused by storm drainage piping installation.

3.12 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground storm drainage piping [**NPS 6 and smaller**] <Insert pipe size range> is to be[**any of**] the following:
 - 1. Service weight, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPL**], [**heavy-duty**], hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 5. [**Solid-wall**] [**Cellular-core**] ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 6. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 7. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- C. Aboveground, storm drainage piping [**NPS 8 and larger**] <Insert pipe size range> is to be[**any of**] the following:
 - 1. Service weight, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPL**], [**heavy-duty**], hubless-piping couplings; and coupled joints.
 - 3. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 4. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 5. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 6. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- D. Underground storm drainage piping [**NPS 6 and smaller**] <Insert pipe size range> shall be[**any of**] the following:
 - 1. [**Extra heavy**] [**Service weight**], cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**caulking materials; and caulked**] joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPL**], [**heavy-duty**], [**cast-iron**], hubless-piping couplings; and coupled joints.
 - 3. [**Solid-wall**] [**Cellular-core**] ABS pipe, ABS socket fittings, and solvent-cemented joints.
 - 4. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 5. Dissimilar Pipe-Material Couplings: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
- E. Underground, storm drainage piping [**NPS 8 and larger**] <Insert pipe size range> is to be[**any of**] the following:
 - 1. [**Extra heavy**] [**Service weight**], cast-iron soil pipe and fittings; [**gaskets; and gasketed**] [**caulking materials; and caulked**] joints.
 - 2. Hubless, cast-iron soil pipe and fittings; [**CISPL**], [**heavy-duty**], [**cast-iron**], hubless-piping couplings; and coupled joints.
 - 3. [**Solid-wall**] [**Cellular-core**] PVC pipe, PVC socket fittings, and solvent-cemented joints.
 - 4. Cellular-core, sewer and drain series, PVC pipe; PVC socket fittings; and solvent-

- cemented joints.
5. Dissimilar Pipe-Material Couplings: [Unshielded] [Shielded], nonpressure transition couplings.
- F. Aboveground storm drainage force mains [NPS 1-1/2 and NPS 2] <Insert pipe size range> is to be[**any of**] the following:
1. Hard copper tube, **Type L** copper pressure fittings, and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
- G. Aboveground storm drainage force mains [NPS 2-1/2 to NPS 6] <Insert pipe size range> is to be[**any of**] the following:
1. Hard copper tube, **Type L** copper pressure fittings, and soldered joints.
 2. Galvanized-steel pipe, pressure fittings, and threaded joints.
 3. Grooved-end, galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
 4. Fitting-type transition couplings if dissimilar pipe materials.

END OF SECTION 221414

SECTION 260010 - SUPPLEMENTAL REQUIREMENTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Supplemental requirements generally applicable to the Work specified in Division 26.
This Section is also referenced by related Work specified in other Divisions.

B. Related Requirements:

1. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 REFERENCES

A. Abbreviations and Acronyms for Electrical Terms and Units of Measure:

1. 8P8C: An 8-position 8-contact modular jack.
2. A: Ampere, unit of electrical current.
3. AC or ac: Alternating current.
4. AFCI: Arc-fault circuit interrupter.
5. AIC: Ampere interrupting capacity.
6. AL, Al, or ALUM: Aluminum.
7. ASD: Adjustable-speed drive.
8. ATS: Automatic transfer switch.
9. AWG: American wire gauge; see ASTM B258.
10. BAS: Building automation system.
11. BIL: Basic impulse insulation level.
12. BIM: Building information modeling.
13. CAD: Computer-aided design or drafting.
14. CATV: Community antenna television.
15. CB: Circuit breaker.
16. cd: Candela, the SI fundamental unit of luminous intensity.
17. CO/ALR: Copper-aluminum, revised.
18. COPS: Critical operations power system.
19. CU or Cu: Copper.
20. CU-AL or AL-CU: Copper-aluminum.
21. dB: Decibel, a unitless logarithmic ratio of two electrical, acoustical, or optical power values.
22. dB(A-weighted) or dB(A): Decibel acoustical sound pressure level with A-weighting applied in accordance with IEC 61672-1.
23. dB(adjusted) or dBa: Decibel weighted absolute noise power with respect to 3.16 pW (minus 85 dBm).
24. dBm: Decibel absolute power with respect to 1 mW.
25. DC or dc: Direct current.
26. DCOA: Designated critical operations area.
27. DDC: Direct digital control (HVAC).
28. EGC: Equipment grounding conductor.
29. ELV: Extra-low voltage.
30. EMF: Electromotive force.
31. EMI: Electromagnetic interference.

- 32. EPM: Electrical preventive maintenance.
- 33. EPS: Emergency power supply.
- 34. EPSS: Emergency power supply system.
- 35. ESS: Energy storage system.
- 36. EV: Electric vehicle.
- 37. EVPE: Electric vehicle power export equipment.
- 38. EVSE: Electric vehicle supply equipment.
- 39. fc: Footcandle, an internationally recognized unit of illuminance equal to one lumen per square foot or 10.76 lx. The simplified conversion 1 fc = 10 lx in the Specifications is common practice and considered adequate precision for building construction activities. When there are conflicts, lux is the primary unit; footcandle is specified for convenience.
- 40. FLC: Full-load current.
- 41. ft: Foot.
- 42. ft-cd: Foot-candle, the antiquated U.S. Standard unit of illuminance, equal to one international candle measured at a distance of one foot, that was superseded in 1948 by the unit "footcandle" after the SI unit candela (cd) replaced the international candle; see "fc,"
- 43. GEC: Grounding electrode conductor.
- 44. GFCI: Ground-fault circuit interrupter.
- 45. GFPE: Ground-fault protection of equipment.
- 46. GND: Ground.
- 47. HACR: Heating, air conditioning, and refrigeration.
- 48. HDPE: High-density polyethylene.
- 49. HID: High-intensity discharge.
- 50. HP or hp: Horsepower.
- 51. HVAC: Heating, ventilating, and air conditioning.
- 52. Hz: Hertz.
- 53. IBT: Intersystem bonding termination.
- 54. inch: Inch. To avoid confusion, the abbreviation "in." is not used.
- 55. IP: Ingress protection rating (enclosures); Internet protocol (communications).
- 56. IR: Infrared.
- 57. IS: Intrinsically safe.
- 58. IT&R: Inspecting, testing, and repair.
- 59. ITE: Information technology equipment.
- 60. kAIC: Kiloampere interrupting capacity.
- 61. kcmil or MCM: One thousand circular mils.
- 62. kV: Kilovolt.
- 63. kVA: Kilovolt-ampere.
- 64. kVAr or kVAR: Kilovolt-ampere reactive.
- 65. kW: Kilowatt.
- 66. kWh: Kilowatt-hour.
- 67. LAN: Local area network.
- 68. lb: Pound (weight).
- 69. lbf: Pound (force).
- 70. LCD: Liquid-crystal display.
- 71. LCDI: Leakage-current detector-interrupter.
- 72. LED: Light-emitting diode.
- 73. Li-ion: Lithium-ion.
- 74. lm: Lumen, the SI derived unit of luminous flux.

- 75. LNG: Liquefied natural gas.
- 76. LP-Gas: Liquefied petroleum gas.
- 77. LRC: Locked-rotor current.
- 78. LV: Low voltage.
- 79. lx: Lux, the SI derived unit of illuminance equal to one lumen per square meter.
- 80. m: Meter.
- 81. MCC: Motor-control center.
- 82. MDC: Modular data center.
- 83. MG set: Motor-generator set.
- 84. MIDI: Musical instrument digital interface.
- 85. MLO: Main lugs only.
- 86. MV: Medium voltage.
- 87. MVA: Megavolt-ampere.
- 88. mW: Milliwatt.
- 89. MW: Megawatt.
- 90. MWh: Megawatt-hour.
- 91. NC: Normally closed.
- 92. Ni-Cd: Nickel-cadmium.
- 93. Ni-MH: Nickel-metal hydride.
- 94. NIU: Network interface unit.
- 95. NO: Normally open.
- 96. NPT: National (American) standard pipe taper.
- 97. OCPD: Overcurrent protective device.
- 98. ONT: Optical network terminal.
- 99. PC: Personal computer.
- 100. PCS: Power conversion system.
- 101. PCU: Power-conditioning unit.
- 102. PF or pf: Power factor.
- 103. PHEV: Plug-in hybrid electric vehicle.
- 104. PLC: Programmable logic controller.
- 105. PLFA: Power-limited fire alarm.
- 106. PoE: Power over Ethernet.
- 107. PV: Photovoltaic.
- 108. PVC: Polyvinyl chloride.
- 109. pW: Picowatt.
- 110. RFI: (electrical) Radio-frequency interference; (contract) Request for interpretation.
- 111. RMS or rms: Root-mean-square.
- 112. RPM or rpm: Revolutions per minute.
- 113. SCADA: Supervisory control and data acquisition.
- 114. SCR: Silicon-controlled rectifier.
- 115. SPD: Surge protective device.
- 116. sq.: Square.
- 117. SWD: Switching duty.
- 118. TCP/IP: Transmission control protocol/Internet protocol.
- 119. TEFC: Totally enclosed fan-cooled.
- 120. TR: Tamper resistant.
- 121. TVSS: Transient voltage surge suppressor.
- 122. UL: (standards) Underwriters Laboratories, Inc.; (product categories) UL, LLC.
- 123. UL CCN: UL Category Control Number.

124. UPS: Uninterruptible power supply.
125. USB: Universal serial bus.
126. UV: Ultraviolet.
127. V: Volt, unit of electromotive force.
128. V(ac): Volt, alternating current.
129. V(dc): Volt, direct current.
130. VA: Volt-ampere, unit of complex electrical power.
131. VAR: Volt-ampere reactive, unit of reactive electrical power.
132. VFC: Variable-frequency controller.
133. VOM: Volt-ohm-multimeter.
134. VPN: Virtual private network.
135. VRLA: Valve regulated lead acid; also called "sealed lead acid (SLA)" or "valve regulated sealed lead acid."
136. W: Watt, unit of real electrical power.
137. Wh: Watt-hour, unit of electrical energy usage.
138. WPT: Wireless power transfer.
139. WPTE: Wireless power transfer equipment.
140. WR: Weather resistant.

B. Abbreviations and Acronyms for Electrical Raceway Types:

1. EMT: Electrical metallic tubing.
2. EMT-A: Aluminum electrical metallic tubing.
3. EMT-S: Steel electrical metallic tubing.
4. EMT-SS: Stainless steel electrical metallic tubing.
5. ENT: Electrical nonmetallic tubing.
6. EPEC: Electrical HDPE underground conduit (thin wall).
7. EPEC-A: Type A electrical HDPE underground conduit.
8. EPEC-B: Type B electrical HDPE underground conduit.
9. ERMC: Electrical rigid metal conduit.
10. ERMC-A: Aluminum electrical rigid metal conduit.
11. ERMC-S: Steel electrical rigid metal conduit.
12. ERMC-S-G: Galvanized-steel electrical rigid metal conduit.
13. ERMC-S-PVC: PVC-coated-steel electrical rigid metal conduit.
14. ERMC-SS: Stainless steel electrical rigid metal conduit.
15. FMC: Flexible metal conduit.
16. FMC-A: Aluminum flexible metal conduit.
17. FMC-S: Steel flexible metal conduit.
18. FMT: Steel flexible metallic tubing.
19. FNMC: Flexible nonmetallic conduit. See "LFNC."
20. HDPE: HDPE underground conduit (thick wall).
21. HDPE-40: Schedule 40 HDPE underground conduit.
22. HDPE-80: Schedule 80 HDPE underground conduit.
23. IMC: Steel electrical intermediate metal conduit.
24. LFMC: Liquidtight flexible metal conduit.
25. LFMC-A: Aluminum liquidtight flexible metal conduit.
26. LFMC-S: Steel liquidtight flexible metal conduit.
27. LFMC-SS: Stainless steel liquidtight flexible metal conduit.
28. LFNC: Liquidtight flexible nonmetallic conduit.
29. LFNC-A: Layered (Type A) liquidtight flexible nonmetallic conduit.

30. LFNC-B: Integral (Type B) liquidtight flexible nonmetallic conduit.
 31. LFNC-C: Corrugated (Type C) liquidtight flexible nonmetallic conduit.
 32. PVC: Rigid PVC conduit.
 33. PVC-40: Schedule 40 rigid PVC conduit.
 34. PVC-80: Schedule 80 rigid PVC Conduit.
 35. PVC-A: Type A rigid PVC concrete-encased conduit.
 36. PVC-EB: Type EB rigid PVC concrete-encased underground conduit.
 37. RGS: See ERM-C-S-G.
 38. RMC: See ERM-C.
 39. RTRC: Reinforced thermosetting resin conduit.
 40. RTRC-AG: Low-halogen, aboveground reinforced thermosetting resin conduit.
 41. RTRC-AG-HW: Heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
 42. RTRC-AG-SW: Standard wall, low-halogen, aboveground reinforced thermosetting resin conduit.
 43. RTRC-AG-XW: Extra heavy wall, low-halogen, aboveground reinforced thermosetting resin conduit.
 44. RTRC-BG: Low-halogen, belowground reinforced thermosetting resin conduit.
- C. Abbreviations and Acronyms for Electrical Single-Conductor and Multiple-Conductor Cable Types:
1. AC: Armored cable.
 2. CATV: Coaxial general-purpose cable.
 3. CATVP: Coaxial plenum cable.
 4. CATVR: Coaxial riser cable.
 5. CI: Circuit integrity cable.
 6. CL2: Class 2 cable.
 7. CL2P: Class 2 plenum cable.
 8. CL2R: Class 2 riser cable.
 9. CL2X: Class 2 cable, limited use.
 10. CL3: Class 3 cable.
 11. CL3P: Class 3 plenum cable.
 12. CL3R: Class 3 riser cable.
 13. CL3X: Class 3 cable, limited use.
 14. CM: Communications general-purpose cable.
 15. CMG: Communications general-purpose cable.
 16. CMP: Communications plenum cable.
 17. CMR: Communications riser cable.
 18. CMUC: Under-carpet communications wire and cable.
 19. CMX: Communications cable, limited use.
 20. DG: Distributed generation cable.
 21. FC: Flat cable.
 22. FCC: Flat conductor cable.
 23. FPL: Power-limited fire-alarm cable.
 24. FPLP: Power-limited fire-alarm plenum cable.
 25. FPLR: Power-limited fire-alarm riser cable.
 26. IGS: Integrated gas spacer cable.
 27. ITC: Instrumentation tray cable.
 28. ITC-ER: Instrumentation tray cable, exposed run.

- 29. MC: Metal-clad cable.
- 30. MC-HL: Metal-clad cable, hazardous location.
- 31. MI: Mineral-insulated, metal-sheathed cable.
- 32. MTW: (machine tool wiring) Moisture-, heat-, and oil-resistant thermoplastic cable.
- 33. MV: Medium-voltage cable.
- 34. NM: Nonmetallic sheathed cable.
- 35. NMC: Nonmetallic sheathed cable with corrosion-resistant nonmetallic jacket.
- 36. NMS: Nonmetallic sheathed cable with signaling, data, and communications conductors, plus power or control conductors.
- 37. NPLF: Non-power-limited fire-alarm circuit cable.
- 38. NPLFP: Non-power-limited fire-alarm circuit cable for environmental air spaces.
- 39. NPLFR: Non-power-limited fire-alarm circuit riser cable.
- 40. NUCC: Nonmetallic underground conduit with conductors.
- 41. OFC: Conductive optical fiber general-purpose cable.
- 42. OFCG: Conductive optical fiber general-purpose cable.
- 43. OFCP: Conductive optical fiber plenum cable.
- 44. OFCR: Conductive optical fiber riser cable.
- 45. OFN: Nonconductive optical fiber general-purpose cable.
- 46. OFNG: Nonconductive optical fiber general-purpose cable.
- 47. OFNP: Nonconductive optical fiber plenum cable.
- 48. OFNR: Nonconductive optical fiber riser cable.
- 49. P: Marine shipboard cable.
- 50. PLTC: Power-limited tray cable.
- 51. PLTC-ER: Power-limited tray cable, exposed run.
- 52. PV: Photovoltaic cable.
- 53. RHH: (high heat) Thermoset rubber, heat-resistant cable.
- 54. RHW: Thermoset rubber, moisture-resistant cable.
- 55. SA: Silicone rubber cable.
- 56. SE: Service-entrance cable.
- 57. SER: Service-entrance cable, round.
- 58. SEU: Service-entrance cable, flat.
- 59. SIS: Thermoset cable for switchboard and switchgear wiring.
- 60. TBS: Thermoplastic cable with outer braid.
- 61. TC: Tray cable.
- 62. TC-ER: Tray cable, exposed run.
- 63. TC-ER-HL: Tray cable, exposed run, hazardous location.
- 64. THW: Thermoplastic, heat- and moisture-resistant cable.
- 65. THHN: Thermoplastic, heat-resistant cable with nylon jacket outer sheath.
- 66. THHW: Thermoplastic, heat- and moisture-resistant cable.
- 67. THWN: Thermoplastic, moisture- and heat-resistant cable with nylon jacket outer sheath.
- 68. TW: Thermoplastic, moisture-resistant cable.
- 69. UF: Underground feeder and branch-circuit cable.
- 70. USE: Underground service-entrance cable.
- 71. XHH: Cross-linked polyethylene, heat-resistant cable.
- 72. XHHW: Cross-linked polyethylene, heat- and moisture-resistant cable.

D. Abbreviations and Acronyms for Electrical Flexible Cord Types:

- 1. SEO: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.

2. SEOW: 600 V extra-hard-usage, hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
3. SEOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp locations.
4. SEOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer covering for damp or wet locations.
5. SJEO: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
6. SJEOW: 300 V hard-usage, junior hard-service cord with thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
7. SJEOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp locations.
8. SJEOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic elastomer insulation and oil-resistant thermoplastic elastomer outer cover for damp or wet locations.
9. SJO: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp locations.
10. SJOW: 300 V hard-usage, junior hard-service cord with thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
11. SJOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp locations.
12. SJOOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer cover for damp or wet locations.
13. SJTO: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
14. SJTOW: 300 V hard-usage, junior hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
15. SJTOO: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp locations.
16. SJTOOW: 300 V hard-usage, junior hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer cover for damp or wet locations.
17. SO: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp locations.
18. SOW: 600 V extra-hard-usage, hard-service cord with thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
19. SOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp locations.
20. SOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoset insulation and oil-resistant thermoset outer covering for damp or wet locations.
21. STO: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp locations.
22. STOW: 600 V extra-hard-usage, hard-service cord with thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.
23. STOO: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic

- insulation and oil-resistant thermoplastic outer covering for damp locations.
24. STOOW: 600 V extra-hard-usage, hard-service cord with oil-resistant thermoplastic insulation and oil-resistant thermoplastic outer covering for damp or wet locations.

E. Definitions:

1. 8-Position 8-Contact (8P8C) Modular Jack: An unkeyed jack with up to eight contacts commonly used to terminate twisted-pair and multiconductor Ethernet cable. Also called a "TIA-1096 miniature 8-position series jack" (8PSJ), or an "IEC 8877 8-pole jack."
 - a. Be careful when suppliers use "RJ45" generically. Obsolete RJ45 jacks used for analog telephone cables have rejection keys. 8P8C jacks used for digital telephone cables and Ethernet cables do not have rejection keys.
2. Basic Impulse Insulation Level (BIL): Reference insulation level expressed in impulse crest voltage with a standard wave not longer than 1.5 times 50 microseconds and 1.5 times 40 microseconds.
3. Cable: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "cable" is (1) a conductor with insulation, or a stranded conductor with or without insulation (single-conductor cable); or (2) a combination of conductors insulated from one another (multiple-conductor cable).
4. Communications Jack: A fixed connecting device designed for insertion of a communications cable plug.
5. Communications Outlet: One or more communications jacks, or cables and plugs, mounted in a box or ring, with a suitable protective cover.
6. Conductor: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "conductor" is (1) a wire or combination of wires not insulated from one another, suitable for carrying an electric current; (2) (National Electrical Safety Code) a material, usually in the form of wire, cable, or bar, suitable for carrying an electric current; or (3) (general) a substance or body that allows a current of electricity to pass continuously along it.
7. Designated Seismic System: A system component that requires design in accordance with Ch. 13 of ASCE/SEI 7 and for which the Component Importance Factor is greater than 1.0.
8. Direct Buried: Installed underground without encasement in concrete or other protective material.
9. Enclosure: The case or housing of an apparatus, or the fence or wall(s) surrounding an installation, to prevent personnel from accidentally contacting energized parts or to protect the equipment from physical damage. Types of enclosures and enclosure covers include the following:
 - a. Cabinet: An enclosure that is designed for either surface mounting or flush mounting and is provided with a frame, mat, or trim in which a swinging door or doors are or can be hung.
 - b. Concrete Box: A box intended for use in poured concrete.
 - c. Conduit Body: A means for providing access to the interior of a conduit or tubing system through one or more removable covers at a junction or terminal point. In the United States, conduit bodies are listed in accordance with outlet box requirements.
 - d. Conduit Box: A box having threaded openings or knockouts for conduit, EMT, or fittings.
 - e. Cutout Box: An enclosure designed for surface mounting that has swinging doors

- or covers secured directly to and telescoping with the walls of the enclosure.
- f. Device Box: A box with provisions for mounting a wiring device directly to the box.
 - g. Extension Ring: A ring intended to extend the sides of an outlet box or device box to increase the box depth, volume, or both.
 - h. Floor Box: A box mounted in the floor intended for use with a floor box cover and other components to complete the floor box enclosure.
 - i. Floor-Mounted Enclosure: A floor box and floor box cover assembly with means to mount in the floor that is sealed against the entrance of scrub water at the floor level.
 - j. Floor Nozzle: An enclosure used on a wiring system, intended primarily as a housing for a receptacle, provided with a means, such as a collar, for surface-mounting on a floor, which may or may not include a stem to support it above the floor level, and is sealed against the entrance of scrub water at the floor level.
 - k. Junction Box: A box with a blank cover that joins different runs of raceway or cable and provides space for connection and branching of the enclosed conductors.
 - l. Outlet Box: A box that provides access to a wiring system having pryout openings, knockouts, threaded entries, or hubs in either the sides or the back, or both, for the entrance of conduit, conduit or cable fittings, or cables, with provisions for mounting an outlet box cover, but without provisions for mounting a wiring device directly to the box.
 - m. Pedestal Floor Box Cover: A floor box cover that, when installed as intended, provides a means for typically vertical or near-vertical mounting of receptacle outlets above the floor's finished surface.
 - n. Pull Box: A box with a blank cover that joins different runs of raceway and provides access for pulling or replacing the enclosed cables or conductors.
 - o. Raised-Floor Box: A floor box intended for use in raised floors.
 - p. Recessed Access Floor Box: A floor box with provisions for mounting wiring devices below the floor surface.
 - q. Recessed Access Floor Box Cover: A floor box cover with provisions for passage of cords to recessed wiring devices mounted within a recessed floor box.
 - r. Ring: A sleeve, which is not necessarily round, used for positioning a recessed wiring device flush with the plaster, concrete, drywall, or other wall surface.
 - s. Ring Cover: A box cover, with raised center portion to accommodate a specific wall or ceiling thickness, for mounting wiring devices or luminaires flush with the surface.
 - t. Termination Box: An enclosure designed for installation of termination base assemblies consisting of bus bars, terminal strips, or terminal blocks with provision for wire connectors to accommodate incoming or outgoing conductors, or both.
- 10. Emergency Systems: Those systems legally required and classed as emergency by municipal, state, federal, or other codes, or by any governmental agency having jurisdiction that are designed to ensure continuity of lighting, electrical power, or both, to designated areas and equipment in the event of failure of the normal supply for safety to human life.
 - 11. Essential Electrical Systems: (healthcare facilities) Those systems designed to ensure continuity of electrical power to designated areas and functions of a healthcare facility during disruption of normal power sources, and also to minimize disruption within the internal wiring system.
 - 12. Fault Limited: Providing or being served by a source of electrical power that is limited to

- not more than 100 W when tested in accordance with UL 62368-1.
- a. The term "fault limited" is intended to encompass most Class 1, 2, and 3 power-limited sources complying with Article 725 of NFPA 70; Class ES1 and ES2 electrical energy sources that are Class PS1 electrical power sources (e.g., USB); and Class ES3 electrical energy sources that are Class PS1 and PS2 electrical power sources (e.g., PoE). See UL 62368-1 for discussion of classes of electrical energy sources and classes of electrical power sources.
 13. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.
 14. Jacket: A continuous nonmetallic outer covering for conductors or cables.
 15. Luminaire: A complete lighting unit consisting of a light source such as a lamp, together with the parts designed to position the light source and connect it to the power supply. It may also include parts to protect the light source or the ballast or to distribute the light.
 16. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the Energy Independence and Security Act (EISA) of 2007.
 17. Multi-Outlet Assembly: A type of surface, flush, or freestanding raceway designed to hold conductors, receptacles, and switches, assembled in the field or at the factory.
 18. Plenum: A compartment or chamber to which one or more air ducts are connected and that forms part of the air distribution system.
 19. Receptacle: A fixed connecting device arranged for insertion of a power cord plug. Also called a power jack.
 20. Receptacle Outlet: One or more receptacles mounted in a box with a suitable protective cover.
 21. Sheath: A continuous metallic covering for conductors or cables.
 22. UL Category Control Number (CCN): An alphabetic or alphanumeric code used to identify product categories covered by UL's Listing, Classification, and Recognition Services.
 23. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - a. Control Voltage: Having electromotive force between any two conductors, or between a single conductor and ground, that is supplied from a battery or other Class 2 or Class 3 power-limited source.
 - b. Line Voltage: (1) (controls) Designed to operate using the supplied low-voltage power without transformation. (2) (transmission lines, transformers, SPDs) The line-to-line voltage of the supplying power system.
 - c. Extra-Low Voltage (ELV): Not having electromotive force between any two conductors, or between a single conductor and ground, exceeding 30 V(ac rms), 42 V(ac peak), or 60 V(dc).
 - d. Low Voltage (LV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 30 V but not exceeding 1000 V.
 - e. Medium Voltage (MV): Having electromotive force between any two conductors, or between a single conductor and ground, that is rated about 1 kV but not exceeding 69 kV.
 - f. High Voltage: (1) (circuits) Having electromotive force between any two conductors, or between a single conductor and ground, that is rated above 69 kV but not exceeding 230 kV. (2) (safety) Having sufficient electromotive force to

inflict bodily harm or injury.

24. Wire: In accordance with NIST NBS Circular 37 and IEEE standards, in the United States for the purpose of interstate commerce, the definition of "wire" is a slender rod or filament of drawn metal. A group of small wires used as a single wire is properly called a "stranded wire." A wire or stranded wire covered with insulation is properly called an "insulated wire" or a "single-conductor cable." Nevertheless, when the context indicates that the wire is insulated, the term "wire" will be understood to include the insulation.

1.3 COORDINATION

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:
1. Notify [**Architect**] [**Construction Manager**] [**Owner**] [**Tenant**] no fewer than [**seven**] <Insert number> days in advance of proposed interruption of electrical service.
 2. Do not proceed with interruption of electrical service without [**Architect's**] [**Construction Manager's**] [**Owner's**] [**Tenant's**] written permission.
 3. Coordinate interruption with systems impacted by outage including, but not limited to, the following:
 - a. Exercising generators.
 - b. Emergency lighting.
 - c. Elevators.
 - d. Fire-alarm systems.
- B. Arrange to provide temporary electrical [**service**] [**or**] [**power**] in accordance with requirements specified in Division 01.

1.4 PREINSTALLATION MEETINGS

- A. Electrical Preconstruction Conference: Schedule conference with Architect and Owner, not later than [**10**] <Insert number> days after notice to proceed. Agenda topics include, but are not limited to, the following:
1. Electrical installation schedule.
 2. Status of power system studies.
 3. Value analysis proposals and requests for substitution of electrical equipment.
 4. Utility work coordination and class of service requests.
 5. Commissioning activities.
 6. Sustainability activities[, **including Measurement and Verification Plan**].

1.5 SEQUENCING

- A. Conduct and submit results of power system studies before submitting Product Data and Shop Drawings for electrical equipment.

1.6 SCHEDULING

- A. <Insert requirements for unusual scheduling coordination>.

1.7 ACTION SUBMITTALS

- A. Coordination Drawings for Structural Supports: Show coordination of structural supports for equipment and devices, including restraints and bracing for control of seismic and wind loads, with other systems, equipment, and structural supports in the vicinity.
- B. Coordination Drawings for Ceiling Areas: Where indicated on drawings, provide reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with

Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which equipment and suspension systems will be attached.
3. Size and location of access panels on ceilings.
4. Elevation, size, and route of sprinkler piping.
5. Elevation, size, and route of plumbing piping.
6. Elevation, size, and route of ductwork.
7. Elevation, size, and route of cable tray.
8. Elevation, size, and route of conduit.
9. Elevation and size of wall-mounted and ceiling-mounted equipment.
10. Access panels.
11. Sprinklers.
12. Air inlets and outlets.
13. Control modules.
14. Luminaires.
15. Communications devices.
16. Speakers.
17. Security devices.
18. Fire-alarm devices.
19. Indicate clear dimensions for maintenance access in front of equipment.
20. Indicate dimensions of fully-open access doors.

- C. Coordination Drawings for Cable Tray Routing: Reflected ceiling plan(s), supplemented by sections and other details, drawn to scale, in accordance with Section 013100 "Project Management and Coordination," on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Elevation, size, and route of cable trays.
2. Relationships between components and adjacent structural, electrical, and mechanical elements.
3. Vertical and horizontal offsets and transitions.
4. Elevation and size of sleeves for wall, ceiling, and floor cable penetrations.
5. Elevation of ceilings and size of ceiling tiles.
6. Locations of access panels on ceilings.
7. Locations where cable tray crosses or parallels sprinkler piping.
8. Locations where cable tray crosses plumbing piping.
9. Locations where cable tray crosses or parallels ductwork.
10. Locations of access panels on ductwork.
11. Locations where cable tray crosses conduit.
12. Items blocking access around cable trays, including the following:
 - a. Light fixtures.
 - b. Speakers.
 - c. Fire-alarm devices.
 - d. Power outlets.
 - e. Wall-mounted equipment.
 - f. Equipment racks.
 - g. Furniture.
 - h. Door swings.
 - i. Building features.

13. Indicate clear dimension between cable tray and walls or obstructions that are closer than **10 ft.**
 14. Highlight locations where cable tray is greater than **3 ft** above ceilings. Explain how personnel access will be accommodated for cable tray maintenance.
- D. Coordination Drawings for Conduit Routing: Conduit 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 conduit groups with common supports.
 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- E. Coordination Drawings for Bus Assembly Routing: Floor plans and sections, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
1. Scaled bus-assembly layouts and relationships between components and adjacent structural, mechanical, and electrical elements.
 2. Vertical and horizontal enclosed bus-assembly runs, offsets, and transitions.
 3. Clearances for access above and to the side of enclosed bus assemblies.
 4. Vertical elevation of enclosed bus assemblies above the floor or bottom of structure.
 5. Support locations, type of support, and weight on each support.
 6. Location of adjacent construction elements including luminaires, HVAC and plumbing equipment, fire sprinklers and piping, signal and control devices, and other equipment.
- F. Coordination Drawings for Large Equipment Indoor Installations:
1. Location plan, drawn to scale, showing heavy equipment or truck access paths to loading dock or other freight access into building. Indicate available width and height of doors or openings.
 2. Floor plan for entry floor and floor where equipment is located, drawn to scale, showing heavy equipment access paths for maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Dimensioned concrete bases, outlines of equipment, conduit entries, and grounding equipment locations.
 - b. If freight elevator must be used, indicate width and height of door and depth of car. Indicate if large equipment must be tipped to use elevator.
 - c. Dimensioned working clearances and dedicated areas below and around electrical equipment where obstructions and tripping hazards are prohibited.
 3. Reflected ceiling plans for entry floor and floor where equipment is located, drawn to scale, on which the following items shown and coordinated with each other, based on input from installers of the items involved:
 - a. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways[, **busways,**] [**and seismic bracing**].
 - b. Location of lighting fixtures, sprinkler piping and sprinklers, ducts and diffusers, and other obstructions, indicating available overhead clearance.
 - c. Dimensioned working clearances and dedicated areas above and around electrical equipment where foreign systems and equipment are prohibited.
- G. Coordination Drawings for Large Equipment Outdoor Installations:
1. Utilities site plan, drawn to scale, showing heavy equipment or truck access paths for

maintenance and replacement, with the following items shown and coordinated with each other, based on input from installers of the items involved:

- a. Fences and walls, dimensioned concrete bases, outlines of equipment, conduit entries, and grounding and bonding locations.
- b. Indicate clear dimensions for fence gates and wall openings.
- c. Indicate depth and type of ground cover, and locations of trees, shrubbery, and other obstructions in access path.
- d. Indicate clear height below tree branches, overhead lines, bridges, and other overhead obstructions in access path, or where cranes and hoists will be needed to handle large electrical equipment.
- e. Support locations, type of support, and weight on each support. Locate structural supports for structure-supported raceways[, **busways,**] [**and seismic bracing**].
- f. Dimensioned working clearances and dedicated areas around electrical equipment.

H. Coordination Drawings for Duct Banks:

1. Show duct profiles and coordination with other utilities and underground structures.
2. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.

1.8 INFORMATIONAL SUBMITTALS

A. Electrical Installation Schedule: At preconstruction meeting, and periodically thereafter as dates change, provide schedule for electrical installation Work to Owner and Architect including, but not limited to, milestone dates for the following activities:

1. Submission of power system studies.
2. Submission of specified coordination drawings.
3. Submission of action submittals specified in Division 26.
4. Orders placed for major electrical equipment.
5. Arrival of major electrical equipment on-site.
6. Preinstallation meetings specified in Division 26.
7. Utility service outages.
8. Utility service inspection and activation.
9. Mockup reviews.
10. Closing of walls and ceilings containing electrical Work.
11. System startup, testing, and commissioning activities for major electrical equipment.
12. System startup, testing, and commissioning activities for emergency lighting.
13. System startup, testing, and commissioning activities for automation systems (SCADA, BMS, lighting, HVAC, fire alarm, fire pump, etc.).
14. Pouring of concrete housekeeping pads for electrical equipment and testing of concrete samples.
15. Requests for special inspections.
16. Requests for inspections by authorities having jurisdiction.

B. Delegated Design Drawings for Structural Masonry Wall Penetrations: Where indicated on Drawings, provide reflected ceiling plan(s), supplemented by elevations, sections, and other details, drawn to scale, signed and sealed by a qualified structural professional engineer, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Location and dimensions of structural members supporting wall.
2. Location and dimensions of columns near penetrations.
3. Location and dimension of headers and lintels.

4. Doors and windows near penetrations.
 5. Location and dimensions of penetrating cuts.
 6. Sprinkler piping and sleeves.
 7. Plumbing piping and sleeves.
 8. Ductwork and sleeves.
 9. Cable tray and sleeves.
 10. Conduit and sleeves.
 11. Firestopping assemblies for rated penetrations.
 12. Structural supports for piping, ductwork, and conduit on both sides of wall.
- C. Welding certificates.
- D. Seismic-Load Performance Certificates: Provide special certification for designated seismic systems as indicated in Paragraph 13.2.2 "Special Certification Requirements for Designated Seismic Systems" of [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16] for all designated seismic-load systems identified on Drawings or in the Specifications.
1. Include the following information:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - d. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
 - e. Provide equipment manufacturer's written certification for each designated active electrical seismic device and system, stating that it will remain operable following the design earthquake. Certification must be based on requirements of ASCE/SEI 7, including shake table testing per ICC-ES AC156 or a similar nationally recognized testing standard procedure acceptable to authorities having jurisdiction[, or experience data as permitted by][ASCE/SEI 7-05][ASCE/SEI 7-10][ASCE/SEI 7-16].
 - f. Provide equipment manufacturer's written certification that components with hazardous contents maintain containment following the design earthquake by methods required in [ASCE/SEI 7-05] [ASCE/SEI 7-10] [ASCE/SEI 7-16].
 - g. Submit evidence demonstrating compliance with these requirements for approval to authorities having jurisdiction after review and acceptance by qualified structural professional engineer.
 2. The following systems and components are Designated Seismic Systems and require written special certification of seismic qualification by manufacturer:
 - a. Equipment, accessories, and components specified in Section 111136 "Vehicle Charging Equipment."
 - b. Hangers and supports specified in Section 260529 "Hangers and Supports for Electrical Systems."
 - c. Conduits and their mounting provisions specified in Section 260533.13 "Conduits for Electrical Systems."
 - d. Boxes and their mounting provisions specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
 - e. Surface raceways and their mounting provisions specified in Section 260533.23

- "Surface Raceways for Electrical Systems."
- f. Seismic restraints specified in [Section 260548 "**Vibration and Seismic Controls for Electrical Systems.**"] [Section 260548.16 "**Seismic Controls for Electrical Systems.**"]
 - g. Cable trays, accessories, and components specified in Section 260536 "Cable Trays for Electrical Systems."
 - h. Equipment, accessories, and components specified in Section 261116.11 "Secondary Unit Substations with Switchgear Secondary."
 - i. Equipment, accessories, and components specified in Section 261116.12 "Secondary Unit Substations with Switchboard Secondary."
 - j. Equipment, accessories, and components specified in Section 261116.13 "Secondary Unit Substations with Motor Control Center Secondary."
 - k. Equipment, accessories, and components specified in Section 261213 "Liquid-Filled, Medium-Voltage Transformers."
 - l. Equipment, accessories, and components specified in Section 261216 "Dry-Type, Medium-Voltage Transformers."
 - m. Equipment, accessories, and components specified in Section 261219 "Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers."
 - n. Equipment, accessories, and components specified in Section 261323 "Medium-Voltage Metal-Enclosed Switchgear."
 - o. Equipment, accessories, and components specified in Section 261326 "Medium-Voltage Metal-Clad Switchgear."
 - p. Equipment, accessories, and components specified in Section 261329 "Medium-Voltage Compartmentalized Switchgear."
 - q. Equipment, accessories, and components specified in Section 262213 "Low-Voltage Distribution Transformers."
 - r. Equipment, accessories, and components specified in Section 262216 "Low-Voltage Buck-Boost Transformers."
 - s. Equipment, accessories, and components specified in Section 262300 "Low-Voltage Switchgear."
 - t. Equipment, overcurrent protective devices, accessories, and components specified in Section 262313 "Paralleling Low-Voltage Switchgear."
 - u. Equipment, accessories, and components specified in Section 262413 "Switchboards."
 - v. Equipment, accessories, and components specified in Section 262416 "Panelboards."
 - w. Equipment, accessories, and components specified in Section 262416.16 "Electronically Operated Circuit-Breaker Panelboards."
 - x. Equipment, accessories, and components specified in Section 262419 "Motor-Control Centers."
 - y. Equipment, accessories, and components specified in Section 262500 "Low-Voltage Enclosed Bus Assemblies."
 - z. Cabinets, enclosures, racks, and their mounting provisions specified in Section 262716 "Electrical Cabinets and Enclosures."
 - aa. Equipment, accessories, and components specified in Section 262733 "Power Distribution Units."
 - bb. Equipment, accessories, and components specified in Section 262816 "Enclosed Switches and Circuit Breakers."
 - cc. Equipment, accessories, and components specified in Section 262913.03 "Manual

- and Magnetic Motor Controllers."
- dd. Equipment, accessories, and components specified in Section 262913.06 "Soft-Start Motor Controllers."
- ee. Equipment, accessories, and components specified in Section 262923 "Variable-Frequency Motor Controllers."
- ff. Equipment, accessories, and components specified in Section 262933 "Controllers for Fire Pump Drivers."
- gg. Equipment, accessories, and components specified in Section 263100 "Photovoltaic Collectors."
- hh. Equipment, accessories, and components specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
- ii. Equipment, accessories, and components specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
- jj. Equipment, accessories, and components specified in Section 263213.19 "Bi-Fuel-Engine-Driven Generator Sets."
- kk. Equipment, accessories, and components specified in Section 263223.13 "Horizontal-Axis Wind Turbines."
- ll. Equipment, accessories, and components specified in Section 263223.16 "Vertical-Axis Wind Turbines."
- mm. Equipment, accessories, and components specified in Section 263323.11 "Central Battery Equipment for Emergency Lighting."
- nn. Equipment, accessories, and components specified in Section 263343 "Battery Chargers."
- oo. Equipment, accessories, and components specified in Section 263353 "Static Uninterruptible Power Supply."
- pp. Equipment, accessories, and components specified in Section 263533 "Power Factor Correction Equipment."
- qq. Equipment, accessories, and components specified in Section 263600 "Transfer Switches."
- rr. Luminaires, accessories, and components specified in Section 265113 "Incandescent Interior Lighting."
- ss. Luminaires, accessories, and components specified in Section 265116 "Fluorescent Interior Lighting."
- tt. Luminaires, accessories, and components specified in Section 265119 "LED Interior Lighting."
- uu. Luminaires, accessories, and components specified in Section 265123 "HID Interior Lighting."
- vv. Luminaires, accessories, and components specified in Section 265213 "Emergency and Exit Lighting."
- ww. Dimmer racks specified in Section 265561 "Theatrical Lighting."
- xx. Poles and support components specified in Section 265613 "Lighting Poles and Standards."
- yy. Luminaires, accessories, and components specified in Section 265568 "Athletic Field Lighting."
- zz. Luminaires, accessories, and components specified in Section 265617 "Fluorescent Exterior Lighting."
- aaa. Luminaires, accessories, and components specified in Section 265619 "LED Exterior Lighting."
- bbb. Luminaires, accessories, and components specified in Section 265621 "HID

Exterior Lighting."
ccc. <Insert additional items>.

- E. Wind-Load Performance Certificates: Provide special certification for systems and components designated on Drawings or in the Specifications to be subject to high wind exposure and impact damage.
1. Include the following information:
 - a. Provide equipment manufacturer's written certification for each designated system and component, stating that it will remain in place and operable following the design wind event and comply with requirements of authorities having jurisdiction.
 - b. Certification must be based on ICC-ES or similar nationally recognized testing standard procedures acceptable to authorities having jurisdiction.
 2. The following systems and components require written special certification of resistance to effects of high wind-load and impact damage by manufacturer:
 - a. <Insert items>.
- F. Qualification Statements:
1. For qualified regional manufacturer.
 2. For structural professional engineer.
 3. For electrical professional engineer.
 4. For lighting professional engineer.
 5. For EPM specialist.
 6. For welder.
 7. For ERMCS-PVC raceway Installer.
 8. For medium-voltage cable Installer.
 9. For medium-voltage duct Installer.
 10. For medium-voltage equipment Installer.
 11. For electrical power monitoring Installer.
 12. For switchboard Installer.
 13. For EVSE Installer.
 14. For generator set Installer.
 15. For lightning protection system Installer.
 16. For theatrical lighting Installer.
 17. For exterior athletic lighting Installer.
 18. For power quality specialist.
 19. For **[medium-voltage and]**low-voltage electrical testing agency and on-site electrical testing supervisor.
 20. For power-limited electrical testing agency and on-site power-limited testing supervisor.
 21. For structural testing and inspecting agency.
 22. For outdoor pole testing and inspecting agency.
 23. For luminaire photometric testing laboratory.
 24. For lighting testing and inspecting agency.

1.9 CLOSEOUT SUBMITTALS

- A. Facility EPM Program Binders:
1. Complete Set: On **[approved online or cloud solution] [and] [USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement]**.
 2. Volumes 2 and 8: Reproducible hardcopy on archival quality, **28 lb**, acid-free, bond paper.

B. Operation and Maintenance Data:

1. Provide emergency operation, normal operation, and preventive maintenance manuals for each system, equipment, and device listed below:
 - a. **<Insert system, equipment, or device>.**
2. Include the following information:
 - a. Manufacturer's operating specifications.
 - b. User's guides for software and hardware.
 - c. Schedule of maintenance material items recommended to be stored at Project site.
 - d. Detailed instructions covering operation under both normal and abnormal conditions.
 - e. Time-current curves for overcurrent protective devices and manufacturer's written instructions for testing and adjusting their settings.
 - f. List of load-current and overload-relay heaters with related motor nameplate data.
 - g. List of lamp types and photoelectric relays used on Project, with ANSI and manufacturers' codes.
 - h. Manufacturer's instructions for setting field-adjustable components.
 - i. Manufacturer's instructions for testing, adjusting, and reprogramming microprocessor controls.
 - j. EPSS: Manufacturer's system checklists, maintenance schedule, and maintenance log sheets in accordance with NFPA 110.
 - k. Exterior pole inspection and repair procedures.

C. Software and Firmware Operational Documentation: Provide software and firmware operational documentation[**in Facility EPM Program Binders**], including the following:

1. Software operating and upgrade manuals.
2. Names, versions, and website addresses for locations of installed software.
3. Device address list.
4. Printout of software application and graphic screens.
5. Testing and adjusting of panic and emergency power features.
6. For lighting controls, include the following:
 - a. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.
 - b. Operation of adjustable zone controls.

D. Software:

1. Program Software Backup: Provide [**username and password for approved online or cloud solution**] [**and**] [**USB media that is clearly and permanently labeled with attached placard on lanyard to prevent misplacement**].
2. Provide to Owner upgrades and unrestricted licenses[**for Government use**] for installed and backup software, including operating systems and programming tools required for operation and maintenance.

1.10 QUALIFICATIONS

- A. Qualified Regional Manufacturer: Manufacturer, possessing qualifications specified in Section 014000 "Quality Requirements," that maintains a service center capable of providing training, parts, and emergency on-site repairs to Project site with response time less than [**eight hours**] **<Insert time>.**
- B. Structural Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in structural engineering[, **including seismic- and wind-load modeling and analysis**].

- C. Electrical Professional Engineer: Professional engineer possessing active qualifications specified in Section 014000 "Quality Requirements," with expertise in electrical engineering, including electrical power system modeling and analysis of electrical safety in accordance with NFPA 70E.
- D. Lighting Professional Engineer: Professional engineer possessing active qualifications in accordance with Section 014000 "Quality Requirements" and the following:
 - 1. Expertise in electrical engineering, lighting design, and structural requirements for exterior poles and standards.
 - 2. Lighting Certified (LC) Professional by the National Council on Qualifications for the Lighting Professions (NCQLP).
- E. EPM Specialist: Recognized experts possessing the following qualifications in accordance with Section 014000 "Quality Requirements" and NFPA 70B:
 - 1. Technical Competence: Person should, by education, training, and experience, be well-rounded in all aspects of electrical maintenance.
 - 2. Administrative and Supervisory Skills: Person should be skilled in planning and development of long-range objectives to achieve specific results and should be able to command respect and solicit cooperation of persons involved in EPM Program development.
- F. Welder: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," with training and certification in accordance with [AWS D1.1/D1.1M] [and] [AWS D1.2/D1.2M].
- G. ERM-C-S-PVC Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by ERM-C-S-PVC manufacturer prior to starting installation.
- H. Medium-Voltage Cable Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with training and manufacturer certification to install, splice, and terminate medium-voltage cable[**in accordance with electrical utility service provider's requirements**].
 - 1. Medium-voltage cable Installer must be approved by <Insert name of electrical utility service provider>.
- I. Medium-Voltage Duct Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with installation of medium-voltage duct banks[**in accordance with electrical utility service provider's requirements**].
 - 1. Medium-voltage duct Installer must be approved by <Insert name of electrical utility service provider>.
- J. Medium-Voltage Equipment Installer: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with hazards and safety requirements associated with installation and operation of medium-voltage equipment[**in accordance with electrical utility service provider requirements**].
 - 1. Medium-voltage equipment Installer must be approved by <Insert name of electrical utility service provider>.

- K. Electrical Power Monitoring Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by manufacturer prior to starting installation.
- L. EVSE Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by EVSE manufacturer prior to starting installation.
- M. Generator Set Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by generator set manufacturer prior to starting installation.
- N. Lightning Protection System Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present **[unexpired UL-Listed Installer, UL Category Control Number OWAY, credentials]** [or] **[unexpired LPI Master Installer credentials]** prior to starting installation.
- O. Theatrical Lighting Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by theatrical lighting manufacturers prior to starting installation.
- P. Exterior Athletic Lighting Installers: Installer possessing active qualifications specified in Section 014000 "Quality Requirements," and able to present unexpired certified Installer credentials issued by exterior athletic lighting manufacturer prior to starting installation.
- Q. Power Quality Specialist: Recognized experts possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction, and able to present unexpired NICET Level 4 credentials with documented experience in power quality testing for installations similar in complexity to this Project.
- R. Low-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
- S. Medium-Voltage Electrical Testing and Inspecting Agency: Entities possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site electrical testing supervisors must have documented certification and experience with testing electrical equipment in accordance with NETA testing standards.
- T. Power-Limited Electrical Testing Agency: Entity possessing active credentials from a qualified electrical testing laboratory recognized by authorities having jurisdiction.
 - 1. On-site power-limited testing supervisor must have BICSI Registered Communications Distribution Designer certification and documented training and experience with testing power-limited equipment in accordance with NETA testing standards.
- U. Structural Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing structural concrete, seismic controls, and wind-load controls.

- V. Outdoor Pole Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience in accordance with ASTM C1093 for foundation testing and inspections.
- W. Luminaire Photometric Testing Laboratory: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" accredited under the NVLAP for Energy Efficient Lighting Products, and complying with applicable IES testing standards.
- X. Lighting Testing and Inspecting Agency: Entity possessing active qualifications specified in Section 014000 "Quality Requirements" with documented training and experience with testing and inspecting lighting installations in accordance with IES LM-5.

1.11 MOCKUPS

- A. Simple Mockups for Coordinating Accessibility of Electrical Devices around Fixed Furnishings and Equipment:
 - 1. Build simple mockups using art supplies and other inexpensive materials for verification of general arrangement, actual dimensions, and accessibility of **<Insert identification of room and fabrication>** by **[Architect] [Owner] [Tenant] <Insert approving stakeholders>** prior to fabrication and installation of Work. Depict products from all Divisions requiring coordination including, but not limited to, fixed furnishings, casework, outlet covers and plates, HVAC controls, exposed raceway, exposed plumbing, equipment, and signage.
- B. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations by Change Order.

1.12 FIELD CONDITIONS

- A. Modeling, analysis, product selection, installation, and quality control for Work specified in Division 26 must comply with requirements specified in Section 260011 "Facility Performance Requirements for Electrical."
- B. Service Conditions for Electrical Power Equipment: Besides conditions specified in Section 260011 "Facility Performance Requirements for Electrical," specified electrical power equipment must be suitable for operation under service conditions specified as usual service conditions in applicable NEMA PB series, IEEE C37 series, and IEEE C57 series standards, except for the following:
 - 1. **<Insert equipment location>**:
 - a. Exposure to significant solar radiation.
 - b. Exposure to fumes, vapors, or dust.
 - c. Exposure to explosive environments.
 - d. Ambient temperature not exceeding **[104 deg F] [122 deg F] [140 deg F] <Insert temperature>**.
 - e. Exposure to hot and humid climate or to excessive moisture, including steam, salt spray, and dripping water.
 - f. Unusual transportation or storage conditions.
 - g. Unusual grounding resistance conditions.
 - h. Unusual space limitations.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
 - 1. **<Insert Project requirements>.**
- B. Preinstallation Testing:
 - 1. **<Insert Project requirements>.**
- C. Evaluation and Assessment:
 - 1. **<Insert Project requirements>.**

3.2 PREPARATION

- A. Protection of In-Place Conditions:
 - 1. **<Insert Project requirements>.**

3.3 DEVELOPMENT OF FACILITY EPM PROGRAM

- A. Facility EPM Program must be developed by qualified EPM specialist.
- B. Conduct Facility EPM Program analysis in accordance with NFPA 70B recommendations.
 - 1. Renovation Projects:
 - a. Facility diagrams must include connected existing equipment for entire facility where known. Areas of uncertainty should be clearly indicated.
 - b. Obtain copies of existing operation and maintenance data and existing Facility EPM Program information from Owner.
 - c. Facility EPM Program analysis should identify existing equipment that does not have available operation and maintenance data, and should explain the Owner's risks because this equipment is not included in Facility EPM Program.
 - d. Data for existing equipment outside scope of Project may be inserted in Facility EPM Program Binders without analysis.
 - e. Data for existing equipment impacted by scope of Project should be analyzed and documented similar to Project's new equipment data as much as possible.
- C. Compile operation and maintenance data from Facility EPM Program analysis and submit **[updated]**Facility EPM Program Binders.

3.4 INSTALLATION OF ELECTRICAL WORK

- A. Unless more stringent requirements are specified in the Contract Documents or manufacturers' written instructions, comply with NFPA 70 and NECA NEIS 1 for installation of Work specified in Division 26. Consult Architect for resolution of conflicting requirements.

3.5 SYSTEM STARTUP

- A. Commissioning Activities:
 - 1. **<Insert requirements>.**

3.6 FIELD QUALITY CONTROL

- A. Administrant for Medium-Voltage Electrical Tests and Inspections:
 - 1. **[Owner] [Tenant]** will engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.

2. Engage qualified medium-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 4. Administer and perform tests and inspections[**with assistance of factory-authorized service representative**].
- B. Administrant for Low-Voltage Electrical Tests and Inspections:
1. **[Owner]** **[Tenant]** will engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
 2. Engage qualified low-voltage electrical testing and inspecting agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 4. Administer and perform tests and inspections[**with assistance of factory-authorized service representative**].
- C. Administrant for Power-Limited Electrical Tests and Inspections:
1. **[Owner]** **[Tenant]** will engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.
 2. Engage qualified power-limited electrical testing and inspecting agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 4. Administer and perform tests and inspections[**with assistance of factory-authorized service representative**].
- D. Administrant for Structural Tests and Inspections:
1. **[Owner]** **[Tenant]** will engage qualified structural testing and inspecting agency to administer and perform tests and inspections.
 2. Engage qualified structural testing and inspecting agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 4. Administer and perform tests and inspections[**with assistance of factory-authorized service representative**].
- E. Administrant for Field Tests and Inspections of Lighting Installations:
1. **[Owner]** **[Tenant]** will engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
 2. Engage qualified lighting testing and inspecting agency to administer and perform tests and inspections.
 3. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 4. Administer and perform tests and inspections[**with assistance of factory-authorized**

service representative].

3.7 CLEANING

A. Waste Management:

1. **<Insert requirements for electrical and electronics waste disposal>.**

3.8 CLOSEOUT ACTIVITIES

A. Demonstration: **[With assistance from factory-authorized service representatives, demonstrate] [Demonstrate]** to Owner's maintenance and clerical personnel **[and building occupants]** how to operate the following systems and equipment:

1. Lighting control devices specified in Section 260923 "Lighting Control Devices."
2. Lighting control systems specified in Section 260943.16 "Addressable Luminaire Lighting Controls."
3. Lighting control systems specified in Section 260943.23 "Relay-Based Lighting Controls."
4. Electronic metering and billing software specified in Section 262713 "Electricity Metering."
5. **<Insert system or equipment>.**

B. **[Provide video recordings of demonstrations to Owner.] [Allow Owner to record demonstrations.]**

C. Training: **[With assistance from factory-authorized service representatives, train] [Train]** Owner's maintenance personnel on the following topics:

1. How to implement **[updated]**Facility EPM Program.
2. How to adjust, operate, and maintain equipment specified in Section 111136 "Vehicle Charging Equipment."
3. How to operate normal and emergency electrical systems, including justifications for, and limitations of, protective device settings recommended in study report specified in Section 260573.16 "Coordination Studies."
4. Electrical power safety fundamentals refresher including arc-flash hazard safety features of electrical power distribution equipment in facility, interpreting arc-flash warning labels, selecting appropriate personal protective equipment, and understanding significance of findings documented in study report specified in Section 260573.19 "Arc-Flash Hazard Analysis."
5. How to adjust, operate, and maintain systems specified in Section 260913 "Electrical Power Monitoring."
6. How to adjust, operate, and maintain devices specified in Section 260923 "Lighting Control Devices."
7. How to adjust, operate, and maintain hardware and software specified in Section 260936 "Modular Dimming Controls."**[Laptop computer must be used in training.]**
8. How to adjust, operate, and maintain hardware and software specified in Section 260943.16 "Addressable Luminaire Lighting Controls."
9. How to adjust, operate, and maintain hardware and software specified in Section 260943.23 "Relay-Based Lighting Controls."
10. How to adjust, operate, and maintain equipment specified in Section 261116.11 "Secondary Unit Substations with Switchgear Secondary."
11. How to adjust, operate, and maintain equipment specified in Section 261116.12 "Secondary Unit Substations with Switchboard Secondary."
12. How to adjust, operate, and maintain equipment specified in Section 261116.13

- "Secondary Unit Substations with Motor Control Center Secondary."
13. How to adjust, operate, and maintain equipment specified in Section 261213 "Liquid-Filled, Medium-Voltage Transformers."
 14. How to adjust, operate, and maintain equipment specified in Section 261216 "Dry-Type, Medium-Voltage Transformers."
 15. How to adjust, operate, and maintain equipment specified in Section 261219 "Pad-Mounted, Liquid-Filled, Medium-Voltage Transformers."
 16. How to adjust, operate, and maintain equipment specified in Section 261323 "Medium-Voltage Metal-Enclosed Switchgear."
 17. How to adjust, operate, and maintain equipment specified in Section 261326 "Medium-Voltage Metal-Clad Switchgear."
 18. How to adjust, operate, and maintain equipment specified in Section 261329 "Medium-Voltage Compartmentalized Switchgear."
 19. How to adjust, operate, and maintain equipment specified in Section 262300 "Low-Voltage Switchgear."
 20. How to adjust, operate, and maintain equipment specified in Section 262313 "Paralleling Low-Voltage Switchgear."
 21. How to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories[, **and to use and reprogram microprocessor-based trip, monitoring, and communication units**] specified in Section 262413 "Switchboards."
 22. How to adjust, operate, and maintain control modules specified in Section 262416.16 "Electronically Operated Circuit-Breaker Panelboards."
 23. How to adjust, operate, and maintain enclosed controllers specified in Section 262419 "Motor-Control Centers."
 24. How to adjust, operate, and maintain hardware and software specified in Section 262713 "Electricity Metering."
 25. How to adjust, operate, and maintain equipment specified in Section 262733 "Power Distribution Units."
 26. How to adjust, operate, and maintain equipment specified in Section 262913.03 "Manual and Magnetic Motor Controllers."
 27. How to adjust, operate, and maintain equipment specified in Section 262913.06 "Soft-Start Motor Controllers."
 28. How to adjust, operate, and maintain equipment specified in Section 262923 "Variable-Frequency Motor Controllers."
 29. How to adjust, operate, and maintain controllers[, **remote alarm panels**] [, **low-suction-shutdown panels**] [, **and to use and reprogram microprocessor-based controls within this equipment**] specified in Section 262933 "Controllers for Fire Pump Drivers."
 30. How to adjust, operate, and maintain equipment specified in Section 263100 "Photovoltaic Collectors."
 31. How to adjust, operate, and maintain equipment specified in Section 263213.13 "Diesel-Engine-Driven Generator Sets."
 32. How to adjust, operate, and maintain equipment specified in Section 263213.16 "Gas-Engine-Driven Generator Sets."
 33. How to adjust, operate, and maintain equipment specified in Section 263213.19 "Bi-Fuel-Engine-Driven Generator Sets."
 34. How to adjust, operate, and maintain equipment specified in Section 263323.11 "Central Battery Equipment for Emergency Lighting."

35. How to adjust, operate, and maintain equipment specified in Section 263343 "Battery Chargers."
 36. How to adjust, operate, and maintain equipment specified in Section 263353 "Static Uninterruptible Power Supply."
 37. How to adjust, operate, and maintain equipment specified in Section 263533 "Power Factor Correction Equipment."
 38. How to adjust, operate, and maintain transfer switches and related equipment, including ground-fault protection system, specified in Section 263600 "Transfer Switches."
 39. How to adjust, operate, and maintain devices specified in Section 264313 "Surge Protective Devices for Low-Voltage Electrical Power Circuits."
 40. How to adjust, operate, and maintain stage lighting equipment specified in Section 265561 "Theatrical Lighting."
 41. How to adjust, operate, and maintain luminaires[**and photoelectric controls**] specified in Section 265617 "Fluorescent Exterior Lighting."
 42. How to adjust, operate, and maintain luminaires[**and photoelectric controls**] specified in Section 265619 "LED Exterior Lighting."
 43. How to adjust, operate, and maintain luminaires[**and photoelectric controls**] specified in Section 265621 "HID Exterior Lighting."
 44. **<Insert system or equipment>.**
- D. **[Provide video recordings of training sessions to Owner.] [Allow Owner to record training sessions.]**

END OF SECTION 260010

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonmetallic underground conduit with conductors, Type NUCC.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Copper building wire.
2. Aluminum building wire.
3. Nonmetallic underground conduit with conductors, Type NUCC.
4. Metal-clad cable, Type MC.
5. Armored cable, Type AC.
6. Photovoltaic cable, Type PV.
7. Mineral-insulated cable, Type MI.
8. Tray cable, Type TC.
9. Fire-alarm wire and cable.
10. Connectors and splices.

B. Sustainable Design Submittals:

1. Product Data: For each conductor and cable indicating lead content.
2. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
3. Product Data: For solvents and adhesives, indicating VOC content.
4. Laboratory Test Reports: For solvents and adhesives, indicating compliance with requirements for low-emitting materials.

C. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 NONMETALLIC UNDERGROUND CONDUIT WITH CONDUCTORS, TYPE NUCC

A. Description: A factory assembly of conductors or cables inside a nonmetallic, smooth wall raceway with a circular cross section.

B. Applicable Standards:

1. Regulatory Requirements: Listed and labeled in accordance with NFPA 70 and marked for intended location and use.
2. General Characteristics:
 - a. Reference Standards: UL 1990.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders:

1. Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

2. Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors must be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 - B. Branch Circuits:
 1. Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
 2. Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.
 - C. ASD Output Circuits Cable: Extra-flexible stranded for all sizes.
 - D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.
 - E. PV Circuits: [**Copper**] [**Aluminum**]. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS
- A. Service Entrance: [**Type THHN/THWN-2, single conductors in raceway**] [**Type XHHW-2, single conductors in raceway**] [**Type USE, single conductor in raceway**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Multiconductor cable, Type SE**].
 - B. Exposed Feeders: [**Type THHN/THWN-2, single conductors in raceway**] [**Type XHHW-2, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].
 - C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: [**Type THHN/THWN-2, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].
 - D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: [**Type THHN/THWN-2, single conductors in raceway**] [**Type XHHW-2, single conductors in raceway**] [**Underground feeder cable, Type UF**].
 - E. Feeders Installed below Raised Flooring: [**Type THHN/THWN-2, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**].
 - F. Feeders in Cable Tray: [**Type THHN/THWN-2, single conductors in raceway**] [**Type XHHW-2, single conductors larger than No. 1/0 AWG**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].
 - G. Exposed Branch Circuits, Including in Crawlspace: [**Type THHN/THWN-2, single conductors in raceway**] [**Armored cable, Type AC**] [**Metal-clad cable, Type MC**] [**Mineral-insulated, metal-sheathed cable, Type MI**] [**Nonmetallic-sheathed cable, Type NM**].
 - H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: [**Type THHN/THWN-2, single**

**conductors in raceway] [Armored cable, Type AC] [Metal-clad cable, Type MC]
[Mineral-insulated, metal-sheathed cable, Type MI] [Nonmetallic-sheathed cable,
Type NM].**

- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: **[Type THHN/THWN-2, single conductors in raceway] [Type XHHW-2, single conductors in raceway] [Underground branch-circuit cable, Type UF].**
- J. Branch Circuits Installed below Raised Flooring: **[Type THHN/THWN-2, single conductors in raceway] [Armored cable, Type AC] [Metal-clad cable, Type MC] [Mineral-insulated, metal-sheathed cable, Type MI].**
- K. Branch Circuits in Cable Tray: **[Type THHN/THWN-2, single conductors in raceway] [Type XHHW-2, single conductors larger than No. 1/0 AWG] [Armored cable, Type AC] [Metal-clad cable, Type MC] [Mineral-insulated, metal-sheathed cable, Type MI] [Nonmetallic-sheathed cable, Type NM].**
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless steel, wire-mesh, strain relief device at terminations to suit application.
- M. ASD Output Circuits: **[Type XHHW-2 in metal conduit] [Type TC-ER cable with braided shield] [Type TC-ER cable with dual tape shield].**
- N. PV Circuits, Type USE-2: For PV source circuits rated at 600 V or less.
- O. PV Circuits, Type PV: For PV source circuits rated at **[600] [1000] [2000] V.**

3.3 INSTALLATION, GENERAL

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points in accordance with Section 260533.13 "Conduits for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material[**and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors**].
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least **[6 inch]** **[12 inch]** of slack.
- D. Comply with requirements in **[Section 284621.11 "Addressable Fire-Alarm Systems"]** **[Section 284621.13 "Conventional Fire-Alarm Systems"]** for connecting, terminating, and identifying wires and cables.

3.5 IDENTIFICATION

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

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test **[service entrance and feeder conductors]** **[and]** **[conductors]** feeding the following critical equipment and services for compliance with requirements:
 - a. **<Insert, in separate subparagraphs, critical equipment and services to be tested>**.
 - 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.

- c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
 - 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports to record the following:
- 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

SECTION 260523 - CONTROL-VOLTAGE ELECTRICAL POWER CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backboards.
 - 2. Twin-axial data highway cable.
 - 3. RS-485 cable.
 - 4. Control cable.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Backboards.
 - 2. Category 5e balanced twisted pair cable.
 - 3. Category 6 balanced twisted pair cable.
 - 4. Category 6a balanced twisted pair cable.
 - 5. Balanced twisted pair cable hardware.
 - 6. Twin-axial data highway cable.
 - 7. RS-232 cable.
 - 8. RS-485 cable.
 - 9. Control cable.
 - 10. Control-circuit conductors.
 - 11. Fire-alarm wire and cable.
- B. Sustainable Design Submittals:
 - 1. Product Data: For each conductor and cable indicating lead content.
 - 2. Environmental Product Declaration: For each product.
 - 3. Health Product Declaration: For each product.
 - 4. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
 - 5. Environmental Product Declaration: For each product.
 - 6. Environmental Product Declaration: For each product.
 - 7. Environmental Product Declaration: For each product.
 - 8. Third-Party Certifications: For each product.
 - 9. Third-Party Certified Life Cycle Assessment: For each product.

1.3 INFORMATIONAL SUBMITTALS

- A. Source quality-control reports.
- B. Field quality-control reports.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: **60 inch** or less.

2. Peak Optical Smoke Density: 0.5 or less.
3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

2.2 BACKBOARDS

- A. Description: Plywood, [**fire-retardant treated**, **3/4 by 48 by 96 inch**]. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with [**flat**] [**eggshell**] [**black**] <Insert color> [**latex**] [**alkyd**] paint. Comply with requirements in Section 099123 "Interior Painting."
 1. Lead Content: Less than 300 parts per million.

2.3 TWIN-AXIAL DATA HIGHWAY CABLE

- A. Standard Cable: NFPA 70, Type CM.
 1. Paired, <Insert number> pairs, [**No. 20**] [**No. 22**] [**No. 24**] AWG, stranded [(**7x28**)] [(**7x30**)] [(**7x32**)] tinned-copper conductors.
 2. Polypropylene insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. PVC jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 6. Flame Resistance: Comply with UL 1685.
 7. Lead Content: Less than 300 parts per million.
- B. Plenum-Rated Cable: NFPA 70, Type CMP.
 1. Paired, <Insert number> pairs, [**No. 20**] [**No. 22**] [**No. 24**] AWG, stranded [(**7x28**)] [(**7x30**)] [(**7x32**)] tinned-copper conductors.
 2. Plastic insulation.
 3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
 4. Plastic jacket.
 5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned-copper drain wire.
 6. Flame Resistance: Comply with NFPA 262.
 7. Lead Content: Less than 300 parts per million.

2.4 RS-485 CABLE

- A. Standard Cable: NFPA 70, Type CMG.
 1. Paired, [**one pair**] [**two pairs**], twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 2. PVC insulation.
 3. Unshielded.
 4. PVC jacket.
 5. Flame Resistance: Comply with UL 1685.
 6. Lead Content: Less than 300 parts per million.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, [**one pair**] [**two pairs**], No. 22 AWG, stranded (7x30) tinned-copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262.
6. Lead Content: Less than 300 parts per million.

2.5 CONTROL CABLE

A. Paired Cable: NFPA 70, Type CMG.

1. [**One**] [**Multi-**]pair, twisted, [**No. 16 AWG, stranded (19x29)**] [**No. 18 AWG, stranded (19x30)**] tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.
6. Lead Content: Less than 300 parts per million.

B. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.

1. [**One**] [**Multi-**]pair, twisted, [**No. 16 AWG, stranded (19x29)**] [**No. 18 AWG, stranded (19x30)**] tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.
6. Lead Content: Less than 300 parts per million.

2.6 SOURCE QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
 1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceway selection and installation requirements for conduits as supplemented or modified in this Section.
- B. Comply with requirements in Section 260533.23 "Surface Raceways for Electrical Systems" for raceway selection and installation requirements for wireways as supplemented or modified in this Section.

- C. Comply with requirements in Section 260533.16 "Boxes and Covers for Electrical Systems" for raceway selection and installation requirements for boxes as supplemented or modified in this Section.
 - 1. Outlet boxes must be no smaller than **2 inch** wide, **3 inch** high, and **2-1/2 inch** deep.
 - 2. Outlet boxes for cables must be no smaller than **4 inch** square by [**1-1/2 inch**] [**2-1/8 inch**] deep with extension ring sized to bring edge of ring to within **1/8 inch** of the finished wall surface.
 - 3. Flexible metal conduit must not be used.
 - D. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
 - E. Install manufactured conduit sweeps and long-radius elbows if possible.
 - F. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the room from overhead.
 - 4. Extend conduits [**3 inch**] <Insert dimension> above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
 - G. Backboards: Install backboards with **96 inch** dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.
- 3.3 INSTALLATION OF CONDUCTORS AND CABLES
- A. Comply with NECA 1.
 - B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; cable must not contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced and must be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 - 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 - 6. Secure and support cables at intervals not exceeding **30 inch** and not more than **6 inch** from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
 - 8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
 - 9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.

10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
 11. Support: Do not allow cables to lie on removable ceiling tiles.
 12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
 13. Provide strain relief.
 14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
 15. Ground wire must be copper, and grounding methods must comply with IEEE C2. Demonstrate ground resistance.
- C. Balanced Twisted Pair Cable Installation:
1. Comply with TIA-568-C.2.
 2. Install termination hardware as specified in Section 271513 "Communications Copper Horizontal Cabling" unless otherwise indicated.
 3. Do not untwist balanced twisted pair cables more than **1/2 inch** at the point of termination to maintain cable geometry.
- D. Installation of Control-Circuit Conductors:
1. Install wiring in raceways.
 2. Use insulated spade lugs for wire and cable connection to screw terminals.
- E. Open-Cable Installation:
1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
 2. Suspend copper cable not in a wireway or pathway a minimum of **8 inch** above ceilings by cable supports not more than [**30 inch**] <Insert dimension> apart.
 3. Cable must not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.
- F. Installation of Cable Routed Exposed under Raised Floors:
1. Install plenum-rated cable only.
 2. Install cabling after the flooring system has been installed in raised floor areas.
 3. Below each feed point, neatly coil a minimum of [**72 inch**] <Insert dimension> of cable in a coil not less than [**12 inch**] <Insert dimension> in diameter.
- G. Separation from EMI Sources:
1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of **5 inch**.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of **12 inch**.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of **24 inch**.
 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment must be as follows:

- a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of **2-1/2 inch.**
- b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of **6 inch.**
- c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of **12 inch.**
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures must be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of **3 inch.**
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of **6 inch.**
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of **48 inch.**
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of **5 inch.**

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.6 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers must use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire must have a unique tag.

3.8 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect

- cabling connections to confirm compliance with TIA-568-C.1.
2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
 3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - B. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
 - C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
 - D. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Intersystem bonding bridge grounding connector.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For each type of product indicated.

B. Shop Drawings: Plans showing dimensioned locations of grounding features described in "Field Quality Control" Article, including the following:

1. Test wells.
2. Rod electrodes.
3. Ring electrodes.
4. Grounding arrangements and connections for separately derived systems.
5. **<Insert items>**.

C. Field Quality-Control Submittals:

1. Field quality-control reports.

D. Sustainable Design Submittals:

1. Environmental Product Declaration: For each product.
2. Health Product Declaration: For each product.
3. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.
4. Environmental Product Declaration: For each product.
5. Environmental Product Declaration: For each product.
6. Environmental Product Declaration: For each product.
7. Third-Party Certifications: For each product.
8. Third-Party Certified Life Cycle Assessment: For each product.
9. Product Data: For each conductor and cable indicating lead content.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. In addition to items specified in Section 260010 "Supplemental Requirements for Electrical," include the following:
 - a. Plans showing locations of grounding features described in "Field Quality Control" Article, including the following:
 - 1) Test wells.
 - 2) Rod electrodes.
 - 3) Ring electrodes.
 - 4) Grounding arrangements and connections for separately derived systems.
 - 5) **<Insert items>**.
 - b. Instructions for periodic testing and inspection of grounding features at **[test wells]** **[ring electrodes]** **[grounding connections for separately derived systems]** **<Insert locations>** based on **[NETA MTS]** **[NFPA 70B]** **<Insert reference>**.
 - 1) Tests must determine if ground-resistance or impedance values remain within specified maximums, and instructions must recommend corrective

action if values do not.

- 2) Include recommended testing intervals.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine facility's 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 electrical system.
- B. Inspect test results of grounding system measured at point of electrical service equipment connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of electrical service equipment only after unsatisfactory conditions have been corrected.

3.2 SELECTION OF BUSBARS

- A. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers **2 inch** minimum from wall, **6 inch** above finished floor unless otherwise indicated.
 - 2. 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.

3.3 SELECTION OF CONNECTORS

- A. 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.

3.4 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Reference Standards:
 - 1. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
 - 1. Conductors:
 - a. Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may

- be subjected to strain, impact, or damage.
2. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
 - a. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 - b. Make connections with clean, bare metal at points of contact.
 - c. Make aluminum-to-steel connections with stainless steel separators and mechanical clamps.
 - d. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
 - e. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
 - f. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 - 1) Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate adjacent parts.
 - 2) Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 - 3) Use exothermic-welded connectors for outdoor locations; if disconnect-type connection is required, use bolted clamp.
 - g. Grounding and Bonding for Piping:
 - 1) Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use bolted clamp connector or bolt lug-type connector to pipe flange by using one of lug bolts of flange. Where dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2) Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with bolted connector.
 - 3) Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
 - h. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install **[tinned]** bonding jumper to bond across flexible duct connections to achieve continuity.
 - i. Grounding for Steel Building Structure: Install driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than **60 ft** apart.
 3. Electrodes:
 - a. Ground Rods: Drive rods until tops are **2 inch** below finished floor or final grade unless otherwise indicated.
 - 1) Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 - 2) Use exothermic welds for below-grade connections.

- b. For grounding electrode system, install at least [**three**] <Insert number> rods spaced at least one-rod length from each other and located at least same distance from other grounding electrodes, and connect to service grounding electrode conductor.
- c. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and must be at least **12 inch** deep, with cover.
 - 1) Install at least one test well for each service unless otherwise indicated. Install at ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- d. Ring Electrode: Install grounding conductor, electrically connected to each building structure ground rod and to each [**steel column**] [**indicated item**], extending around perimeter of [**building**] [**area or item indicated**].
 - 1) Install tinned-copper conductor not less than [**2/0 AWG**] <Insert wire size> for ring electrode and for taps to building steel.
 - 2) Bury ring electrode not less than [**24 inch**] <Insert dimension> from building's foundation.
- e. Concrete-Encased Electrode (Ufer Ground):
 - 1) Fabricate in accordance with NFPA 70; use minimum of [**20 ft**] <Insert dimension> of bare copper conductor not smaller than [**4 AWG**] <Insert wire size>.
 - a) If concrete foundation is less than [**20 ft**] <Insert dimension> long, coil excess conductor within base of foundation.
 - b) Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
 - 2) Fabricate in accordance with NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least **20 ft** long. If reinforcing is in multiple pieces, connect together by usual steel tie wires or exothermic welding to create required length.
- 4. Grounding at Service:
 - a. Equipment grounding conductors and grounding electrode conductors must be connected to ground bus. Install main bonding jumper between neutral and ground buses.
- 5. Grounding Separately Derived Systems:
 - a. Generator: Install grounding electrode(s) at generator location. Electrode must be connected to equipment grounding conductor and to frame of generator.
- 6. Grounding Underground Distribution System Components:
 - a. Duct-Bank Grounding Conductor: Bury **12 inch** above duct bank when indicated as part of duct-bank installation.
 - b. Comply with IEEE C2 grounding requirements.
 - c. Grounding Manholes and Handholes: Install driven ground rod through manhole or handhole floor, close to wall, and set rod depth so **4 inch** will extend above finished floor. If necessary, install ground rod before manhole is placed and provide 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from **2 inch** above to **6 inch** 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 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields in accordance with manufacturer's published instructions with splicing and termination kits.
 - e. Pad-Mounted Transformers and Switches: Install two ground rods and ring electrode around pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than 2 AWG for ring electrode and for taps to equipment grounding terminals. Bury ring electrode not less than **6 inch** from foundation.
7. Equipment Grounding:
- a. Install insulated equipment grounding conductors with feeders and branch circuits.
 - b. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
 - 1) Feeders and branch circuits.
 - 2) Lighting circuits.
 - 3) Receptacle circuits.
 - 4) Single-phase motor and appliance branch circuits.
 - 5) Three-phase motor and appliance branch circuits.
 - 6) Flexible raceway runs.
 - 7) Armored and metal-clad cable runs.
 - 8) Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 9) X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
 - c. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
 - d. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
 - e. Isolated Grounding Receptacle Circuits: Install insulated equipment grounding conductor connected to receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable derived system or service unless otherwise indicated.
 - f. Isolated Equipment Enclosure Circuits: For designated equipment supplied by branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of applicable

- derived system or service unless otherwise indicated.
- g. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
 - h. Metallic Fences: Comply with requirements of IEEE C2.
 - 1) Grounding Conductor: Bare[, **tinned**] copper, not less than [**8 AWG**] **<Insert wire size>**.
 - 2) Gates: Must be bonded to grounding conductor with flexible bonding jumper.
 - 3) Barbed Wire: Strands must be bonded to grounding conductor.
8. Fence Grounding: Install at maximum intervals of [**1500 ft**] **<Insert lesser distance if grounding resistance is high>** except as follows:
- a. Fences within **100 ft** of Buildings, Structures, Walkways, and Roadways: Ground at maximum intervals of [**750 ft**] **<Insert lesser distance if grounding resistance is high>**.
 - 1) Gates and Other Fence Openings: Ground fence on each side of opening.
 - a) Bond metal gates to gate posts.
 - b) Bond across openings, with and without gates, except at openings indicated as intentional fence discontinuities. Use 2 AWG wire and bury it at least **18 inch** below finished grade.
 - b. Protection at Crossings of Overhead Electrical Power Lines: Ground fence at location of crossing and at maximum distance of **150 ft** on each side of crossing.
 - c. Grounding Method: At each grounding location, drive grounding rod vertically until top is **6 inch** below finished grade. Connect rod to fence with 6 AWG conductor. Connect conductor to each fence component at grounding location.
 - d. Bonding Method for Gates: Connect bonding jumper between gate post and gate frame.
 - e. Bonding to Lightning-Protection System: If fence terminates at lightning-protected building or structure, ground fence and bond fence grounding conductor to lightning-protection down conductor or lightning-protection grounding conductor, complying with NFPA 780.

3.5 FIELD QUALITY CONTROL

- A. [**Acceptance**] Testing Preparation:
 - 1. **<Insert requirements>**.
- B. Field tests and inspections must be witnessed by [**Architect**] [**Tenant**] [**authorities having jurisdiction**] **<Insert names or titles of witnesses>**.
- C. Tests and Inspections:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with calibrated torque wrench in accordance with manufacturer's published instructions.
 - 3. Test completed grounding system at each location where maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal[, **at ground test wells**][, **and at individual ground rods**]. Make tests at ground rods before conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of

precipitation and without soil being moistened by means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

- b. Perform tests by fall-of-potential method in accordance with IEEE Std 81.
 - c. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
 - 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to record of tests and observations. Include number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Nonconforming Work:
- 1. Grounding system will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective components and retest.
- E. Collect, assemble, and submit test and inspection reports.
- 1. Report measured ground resistances that exceed the following values:
 - a. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: **[10 Ω] <Insert ohms>**.
 - b. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: **[5 Ω] <Insert ohms>**.
 - c. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: **[3 Ω] <Insert ohms>**.
 - d. Power Distribution Units or Panelboards Serving Electronic Equipment: **[1 Ω] [3 Ω] <Insert ohms>**.
 - e. Substations and Pad-Mounted Equipment: **[5 Ω] <Insert ohms>**.
 - f. Manhole Grounds: **[10 Ω] <Insert ohms>**.
 - g. **<Insert application and maximum ground-resistance>**.
- 3.6 PROTECTION
- A. After installation, protect grounding and bonding cables and equipment from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fabricated metal equipment support assemblies.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.
 - j. **<Insert product type>**.
2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: [**Signed and sealed by a qualified professional engineer.**] For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.
2. Slotted support systems.
3. Equipment supports.
4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.

C. Delegated Design Submittals: For hangers and supports for electrical systems.

1. Include design calculations and details of hangers.
2. Include design calculations for seismic restraints.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified structural professional engineer to design hanger and support system.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
1. Flame Rating: Class 1.
 2. Self-extinguishing according to ASTM D635.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 SELECTION

- A. Comply with the following standards for selection and installation of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA NEIS 101
 - 2. NECA NEIS 102.
 - 3. NECA NEIS 105.
 - 4. NECA NEIS 111.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways specified in Section 260533.13 "Conduits for Electrical Systems."
- D. Comply with requirements for boxes specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Provide [**vibration**] [**and**] [**seismic**] controls with hangers and supports in accordance with requirements specified in ["Section 260548 "Vibration and Seismic Controls for Electrical Systems.""] ["Section 260548.16 "Seismic Controls for Electrical Systems.""]
- F. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and ERM as [**required by**] [**scheduled in NECA NEIS 1, where its Table 1 lists maximum spacings that are less than those stated in**] NFPA 70. Minimum rod size must be **1/4 inch** in diameter.
- G. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted [**or other**] support system, sized so capacity can be increased by at least [**25**] **<Insert number>** percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with [**two-bolt conduit clamps**] [**single-bolt conduit clamps**] [**single-bolt conduit clamps using spring friction action for retention in support channel**].
- H. Spring-steel clamps designed for supporting single conduits without bolts may be used for **1-1/2 inch** and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 INSTALLATION OF SUPPORTS

- A. Comply with NECA NEIS 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA NEIS 1, [**EMT**] [**IMC**]

[and] [ERMC] may be supported by openings through structure members, in accordance with NFPA 70.

- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination must be weight of supported components plus **200 lb**.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete **4 inch** thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than **4 inch** thick.
 - 6. To Steel: [**Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts**] [**Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69**] [**Spring-tension clamps**].
 - 7. To Light Steel: Sheet metal screws.
 - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate[**by means that comply with seismic-restraint strength and anchorage requirements**].
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M. Submit welding certificates.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than **4 inch** larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use [**3000 psi**] <Insert value>, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's 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.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup:

1. Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - a. Apply paint by brush or spray to provide minimum dry film thickness of **2.0 mils**.
2. Comply with requirements in [Section 099113 "Exterior Painting"] [Section 099123 "Interior Painting"] [and] [Section 099600 "High-Performance Coatings"] <Insert painting Sections> for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533.13 - CONDUITS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.
 - 3. Section 260519 "Low-Voltage for Electrical Power Conductors and Cables" for nonmetallic underground conduit with conductors (Type NUCC).
 - 4. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior duct banks, manholes, and underground utility construction.

1.2 DEFINITIONS

- A. Conduit: A structure containing one or more duct raceways.
- B. Duct Raceway: A single enclosed raceway for conductors or cable.
- C. Duct Bank: An arrangement of conduit providing one or more continuous duct raceways between two points.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Type EMT-A and Type EMT-SS duct raceways and elbows.
 - 2. Type EMT-S duct raceways and elbows.
 - 3. Type ENT duct raceways and fittings.
 - 4. Type HDPE and Type EPEC duct raceways and fittings.
 - 5. Type ERMC-A and Type ERMC-SS duct raceways, elbows, couplings, and nipples.
 - 6. Type ERMC-S duct raceways, elbows, couplings, and nipples.
 - 7. Type FMC-S and Type FMC-A duct raceways.
 - 8. Type FMT duct raceways.
 - 9. Type IMC duct raceways.
 - 10. Type LFMC duct raceways.
 - 11. Type LFNC duct raceways.
 - 12. Type PVC duct raceways and fittings.
 - 13. Type RTRC-AG duct raceways and fittings.
 - 14. Type RTRC-BG duct raceways and fittings.
 - 15. Fittings for conduit, tubing, and cable.
 - 16. Electrically conductive corrosion-resistant compounds for threaded conduit.
 - 17. Solvent cements.
- B. Sustainable design submittals.
 - 1. Solvent cements.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Type EMT-A and Type EMT-SS duct raceways and elbows.
2. Type EMT-S duct raceways and elbows.
3. Type ENT duct raceways and fittings.
4. Type HDPE and Type EPEC duct raceways and fittings.
5. Type ERMC-A and Type ERMC-SS duct raceways, elbows, couplings, and nipples.
6. Type ERMC-S duct raceways, elbows, couplings, and nipples.
7. Type FMC-S and Type FMC-A duct raceways.
8. Type FMT duct raceways.
9. Type IMC duct raceways.
10. Type LFMC duct raceways.
11. Type LFNC duct raceways.
12. Type PVC duct raceways and fittings.
13. Type RTRC-AG duct raceways and fittings.
14. Type RTRC-BG duct raceways and fittings.
15. Fittings for conduit, tubing, and cable.
16. Electrically conductive corrosion-resistant compounds for threaded conduit.
17. Solvent cements.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 SELECTION OF CONDUITS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of duct raceways. Consult Architect for resolution of conflicting requirements.
- B. Special Instructions Regarding HDPE Conduits: Although Article 353 of NFPA 70 permits use of HDPE conduits where encased in concrete aboveground, UL CCN EAZX listing requirements state that HDPE[**and EPEC**] underground conduits are intended only for use where direct buried with or without being encased in concrete. Specified Type HDPE[**and Type EPEC**] underground conduits are not permitted to be used aboveground on Project.
- C. Outdoors:
1. Exposed and Subject to Severe Physical Damage: **[ERMC] [IMC]**.
 2. Exposed and Subject to Physical Damage: **[ERMC] [IMC] [Corrosion-resistant EMT]**.
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 - b. **<Insert designations of applicable spaces or locations>**.
 3. Exposed and Not Subject to Physical Damage: **[ERMC] [IMC] [Corrosion-resistant EMT] [PVC-80] [RTRC-AG]**.
 4. Concealed Aboveground: **[ERMC] [IMC] [EMT] [PVC-80] [PVC-40] [RTRC-AG]**.
 5. Direct Buried: **[PVC-80] [PVC-40] [HDPE-80] [HDPE-40] [RTRC-BG]**.
 6. Concrete Encased Not in Trench: **[PVC-80] [PVC-40] [PVC-A] [RTRC-BG]**.
 7. Concrete Encased in Trench: **[PVC-80] [PVC-40] [PVC-A] [PVC-EB] [HDPE-80] [HDPE-40] [EPEC-A] [EPEC-B] [RTRC-BG]**.
 8. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **[LFMC] [LFNC-A] [LFNC-B]**.
- D. Indoors:

1. Hazardous Classified Locations: **[ERMC] [IMC]**.
 2. Exposed and Subject to Severe Physical Damage: **[ERMC] [IMC]**. Locations include the following:
 - a. Loading docks.
 - 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>**.
 3. Exposed and Subject to Physical Damage: **[ERMC] [IMC] [EMT]**. Locations include the following:
 - a. Locations less than 2.5 m (8 ft) above finished floor.
 - b. Stub-ups to above suspended ceilings.
 - c. **<Insert designations of applicable spaces or locations>**.
 4. Exposed and Not Subject to Physical Damage: **[ERMC] [IMC] [EMT] [PVC-80] [RTRC-AG]**.
 5. Concealed in Ceilings and Interior Walls and Partitions: **[ERMC] [IMC] [EMT] [PVC-80] [PVC-40] [RTRC-AG]**.
 6. Damp or Wet Locations: **[ERMC] [IMC] [RTRC-AG] [Corrosion-resistant EMT]**.
 7. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **[LFMC] [FMC] [LFNC-A] [LFNC-B]**.
 8. Circuits Operating Above 60 Hz: **[EMT-A] [ERMC-A] [RTRC-AG]**. Provide nonmetallic sleeve where aluminum duct raceways pass through concrete.
- E. Duct Fittings: Select fittings in accordance with NEMA FB 2.10 guidelines.
1. ERMC and IMC: Provide threaded-type fittings unless otherwise indicated.
- 3.2 INSTALLATION OF CONDUITS FOR ELECTRICAL SYSTEMS
- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
1. Type EMT-A: Article 358 of NFPA 70 and NECA NEIS 102.
 2. Type EMT-SS: Article 358 of NFPA 70 and NECA NEIS 101.
 3. Type EMT-S: Article 358 of NFPA 70 and NECA NEIS 101.
 4. Type ENT: Article 362 of NFPA 70 and NECA NEIS 102.
 5. Type HDPE and Type EPEC: Article 353 of NFPA 70 and NECA NEIS 111.
 6. Type ERMC-A: Article 344 of NFPA 70 and NECA NEIS 102.
 7. Type ERMC-SS: Article 344 of NFPA 70 and NECA NEIS 101.
 8. Type ERMC-S: Article 344 of NFPA 70 and NECA NEIS 101.
 9. Type FMC-S: Article 348 of NFPA 70 and NECA NEIS 101.
 10. Type FMC-A: Article 348 of NFPA 70 and NECA NEIS 102.
 11. Type FMT: Article 360 of NFPA 70 and NECA NEIS 101.
 12. Type IMC: Article 342 of NFPA 70 and NECA NEIS 101.
 13. Type LFMC: Article 350 of NFPA 70 and NECA NEIS 101.
 14. Type LFNC: Article 342 of NFPA 70 and NECA NEIS 111.
 15. Type PVC: Article 356 of NFPA 70 and NECA NEIS 111.
 16. Type RTRC: Article 355 of NFPA 70 and NECA NEIS 111.
 17. Expansion Fittings: NEMA FB 2.40.

18. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. General Requirements for Installation of Duct Raceways:
 - a. Complete duct raceway installation before starting conductor installation.
 - b. Provide stub-ups through floors with coupling threaded inside for plugs, set flush with finished floor. Plug coupling until conduit is extended above floor to final destination or a minimum of **2 ft** above finished floor.
 - c. Install no more than equivalent of three 90-degree bends in conduit run[**except for control wiring conduits, for which no more than equivalent of two 90-degree fewer bends are permitted**]. Support within **12 inch** of changes in direction.
 - d. Make bends in duct raceway using large-radius preformed ells except for parallel bends. Field bending must be in accordance with NFPA 70 minimum radii requirements. Provide only equipment specifically designed for material and size involved.
 - e. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
 - f. Support conduit within **12 inch** of enclosures to which attached.
 - g. Install duct sealing fittings at accessible locations in accordance with NFPA 70 and fill them with listed sealing compound. For concealed duct raceways, install fitting in flush steel box with blank cover plate having finish similar to that of adjacent plates or surfaces. Install duct sealing fittings in accordance with NFPA 70.
 - h. Install devices to seal duct raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal interior of duct raceways at the following points:
 - 1) Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2) Where an underground service duct raceway enters a building or structure.
 - 3) Conduit extending from interior to exterior of building.
 - 4) Conduit extending into pressurized duct raceway and equipment.
 - 5) Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6) Where otherwise required by NFPA 70.
 - i. Do not install duct raceways or electrical items on "explosion-relief" walls or rotating equipment.
 - j. Do not install conduits within **2 inch** of the bottom side of a metal deck roof.
 - k. Keep duct raceways at least **6 inch** away from parallel runs of flues and steam or hot-water pipes. Install horizontal duct raceway runs above water and steam piping.
 - l. Cut conduit perpendicular to the length. For conduits metric designator 53 (trade size 2) and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Ream inside of conduit to remove burrs.
 - m. Install pull wires in empty duct raceways. Provide polypropylene or monofilament plastic line with not less than **200 lb** tensile strength. Leave at least **12 inch** of slack at both ends of pull wire. Cap underground duct raceways designated as spare above grade alongside duct raceways in use.
 - n. Install duct raceways square to the enclosure and terminate at enclosures without hubs with locknuts on both sides of enclosure wall. Install locknuts hand tight, plus one-quarter turn more.
 - 1) Termination fittings with shoulders do not require two locknuts.

- o. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to metric designator 35 (trade size 1-1/4) and insulated throat metal bushings on metric designator 41 (trade size 1-1/2) and larger conduits terminated with locknuts. **[Install insulated throat metal grounding bushings on service conduits].**
- 2. Types EMT-A, ERM-C-A, and FMC-A: Do not install aluminum duct raceways or fittings in contact with concrete or earth.
- 3. Types ERM-C and IMC:
 - a. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound that maintains electrical conductivity to threads of duct raceway and fittings before making up joints. Follow compound manufacturer's published instructions.
- 4. Type ERM-C-S-PVC:
 - a. Follow manufacturer's installation instructions for clamping, cutting, threading, bending, and assembly.
 - b. Provide PVC-coated sealing locknut for exposed male threads transitioning into female NPT threads that do not have sealing sleeves, including transitions from PVC couplings/female adapters to Type ERM-C-S-PVC elbows in direct-burial applications. PVC-coated sealing locknuts must not be used in place of conduit hub. PVC-coated sealing locknut must cover exposed threads on Type ERM-C-S-PVC duct raceway.
 - c. Coat field-cut threads on PVC-coated duct raceway with manufacturer-approved corrosion-preventing conductive compound prior to assembly.
- 5. Types FMC, LFMC, and LFNC:
 - a. Provide a maximum of **[36 inch]** **[72 inch]** of flexible conduit for **[recessed and semirecessed luminaires]**, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
- 6. Types PVC, HDPE, and EPEC:
 - a. Do not install Type PVC, Type HDPE, or Type EPEC conduit where ambient temperature exceeds **[122 deg F]** **<Insert temperature>**. Conductor ratings must be limited to 75 deg C except where installed in a trench outside buildings with concrete encasement, where 90 deg C conductors are permitted.
 - b. Comply with manufacturer's published instructions for solvent welding and fittings.
- 7. Type RTRC: Do not install Type RTRC conduit where ambient temperature exceeds **[230 deg F]** **<Insert temperature>**.
- 8. Duct Raceways Embedded in Slabs:
 - a. **[Run duct raceways larger than metric designator 27 (trade size 1) below concrete slab]** [Run duct raceways larger than metric designator 27 (trade size 1) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place duct raceway close to slab support. Secure duct raceways to reinforcement at maximum **10 ft intervals**].
 - b. Arrange duct raceways to cross building expansion joints with expansion fittings at right angles to the joint.
 - c. Arrange duct raceways to ensure that each is surrounded by minimum of **[1 inch]** **[2 inch]** **<Insert dimension>** of concrete without voids.
 - d. Do not embed threadless fittings in concrete unless locations have been specifically approved by Architect.
 - e. Change from ENT to **[PVC-80]** **[PVC-40]** **[ERM-C]** **[or]** **[IMC]** before rising

- above floor.
9. Stub-ups to Above Recessed Ceilings:
 - a. Provide EMT, IMC, or ERM C for duct raceways.
 - b. Provide a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
 10. Duct Raceway Terminations at Locations Subject to Moisture or Vibration:
 - a. Provide insulating bushings to protect conductors, including conductors smaller than 4 AWG. **[Install insulated throat metal grounding bushings on service conduits]**.
 11. Duct Fittings: Install fittings in accordance with NEMA FB 2.10 guidelines.
 - a. ERM C-S-PVC: Provide only fittings listed for use with this type of conduit. Patch and seal joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Provide sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
 - b. EMT: Provide **[setscrew]** **[compression]**, **[steel]** **[cast-metal]** fittings. Comply with NEMA FB 2.10.
 - c. Flexible Conduit: Provide only fittings listed for use with flexible conduit type. Comply with NEMA FB 2.20.
 12. Expansion-Joint Fittings:
 - a. Install in runs of aboveground PVC that are located where environmental temperature change may exceed **30 deg F** and that have straight-run length that exceeds **25 ft**. Install in runs of aboveground ERM C **[and EMT]** conduit that are located where environmental temperature change may exceed **100 deg F** and that have straight-run length that exceeds **100 ft**.
 - b. Install type and quantity of fittings that accommodate temperature change listed for the following locations:
 - 1) Outdoor Locations Not Exposed to Direct Sunlight: **[125 deg F]** **<Insert temperature>** temperature change.
 - 2) Outdoor Locations Exposed to Direct Sunlight: **[155 deg F]** **<Insert temperature>** temperature change.
 - 3) Indoor Spaces Connected with Outdoors without Physical Separation: **[125 deg F]** **<Insert temperature>** temperature change.
 - 4) Attics: **[135 deg F]** **<Insert temperature>** temperature change.
 - 5) **<Insert location and corresponding temperature change>**.
 - c. Install fitting(s) that provide expansion and contraction for at least **0.00041 inch per foot of length of straight run per deg F** 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** of temperature change for metal conduits.
 - d. Install expansion fittings at locations where conduits cross building or structure expansion joints.
 - e. Install expansion-joint fitting with position, mounting, and piston setting selected in accordance with manufacturer's published instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
 13. Duct Raceways Penetrating Rooms or Walls with Acoustical Requirements: Seal duct raceway openings on both sides of rooms or walls with acoustically rated putty **[or firestopping]**.
 14. Identification: Provide labels for conduit assemblies, duct raceways, and associated

electrical equipment.

a. Provide warning signs.

15. **<Insert more stringent installation requirements that supplement or supersede listed standards and manufacturers' published instructions>.**

D. Interfaces with Other Work:

1. Coordinate installation of new products for **<Insert system or product family/category>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>.**
2. Coordinate with Section 078413 "Penetration Firestopping" for installation of firestopping at penetrations of fire-rated floor and wall assemblies.
3. Coordinate with Section 260529 "Hangers and Supports for Electrical Systems" for installation of conduit hangers and supports.
4. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>.**
 - a. **<Insert requirements for transition between this Section and related Work>.**

3.3 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and 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 260533.13

SECTION 260533.16 - BOXES AND COVERS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cover plates for device boxes.

B. Related Requirements:

1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

B. Shop Drawings:

1. Shop drawings for floor boxes.

C. Samples:

1. Floor box samples for initial selection.
2. Raised floor box samples for initial selection.
3. Recessed access-floor box samples for initial selection.
4. Concrete box samples for initial selection.

D. Sustainable design submittals.

1. Nonmetallic outlet boxes, device boxes, rings, and covers.
2. Junction boxes and pull boxes.
3. Cover plates for device boxes.

1.3 INFORMATIONAL SUBMITTALS

A. Manufacturers' Published Instructions:

1. Metallic outlet boxes, device boxes, rings, and covers.
2. Nonmetallic outlet boxes, device boxes, rings, and covers.
3. Junction boxes and pull boxes.
4. Cover plates for device boxes.
5. Hoods for outlet boxes.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 PREPARATION

A. Shop Drawings: Prepare and submit the following:

1. Shop Drawings for Floor Boxes: Show that floor boxes are located to avoid interferences and are structurally allowable. Indicate floor thickness **[at location]** where boxes are embedded in concrete floors and underfloor clearances where boxes are installed in raised floors.

3.2 SELECTION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Unless more stringent requirements are specified in Contract Documents or manufacturers' published instructions, comply with NFPA 70 for selection of boxes and enclosures. Consult Architect for resolution of conflicting requirements.
- B. Degree of Protection:
 1. Outdoors:
 - a. **[Type 3R] [Type 4] [Type 3]** unless otherwise indicated.
 - b. Locations Exposed to Hosedown: **[Type 4] [Type 6] [Type 6P]**.
 - c. Locations Subject to Potential Flooding: Type 6P.
 - d. Locations Aboveground Where Mechanism Must Operate When Ice Covered: Type 3S.
 - e. Locations in-Ground or Exposed to Corrosive Agents: **[Type 4X] [Type 6P] [Type 3RX]**.
 - f. Locations in-Ground or Exposed to Corrosive Agents Where Mechanism Must Operate When Ice Covered: Type 3SX.
 2. Indoors:
 - a. Type 1 unless otherwise indicated.
 - b. Damp or Dusty Locations: **[Type 12] [Type 2] [Type 4] [Type 5]**.
 - c. Surface Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: Type 12.
 - d. Flush Mounted in Kitchens and Other Locations Exposed to Oil or Coolants: **[Type 12] [Type 12K]**.
 - e. Locations Exposed to Airborne Dust, Lint, Fibers, or Flyings: **[Type 4] [Type 6]**.
 - f. Locations Exposed to Hosedown: **[Type 4] [Type 6] [Type 6P]**.
 - g. Locations Exposed to Brief Submersion: **[Type 6] [Type 6P]**.
 - h. Locations Exposed to Prolonged Submersion: Type 6P.
 - i. Locations Exposed to Corrosive Agents: **[Type 4X] [Type 6P]**.
 - j. Locations Exposed to Spraying Oil or Coolants: Type 13.
- C. Exposed Boxes Installed Less Than 2.5 m (8 ft) Above Floor:
 1. **[Provide cast-metal boxes] [Boxes with knockouts or unprotected openings are prohibited]**.
 2. Provide exposed cover. Flat covers with angled mounting slots or knockouts are prohibited.

3.3 INSTALLATION OF BOXES AND COVERS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 1. Outlet, Device, Pull, and Junction Boxes: Article 314 of NFPA 70.
 2. Consult Architect for resolution of conflicting requirements.

C. Special Installation Techniques:

1. Provide boxes in wiring and raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures.
2. 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.
3. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box, whether installed indoors or outdoors.
4. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
5. Locate boxes so that cover or plate will not span different building finishes.
6. Support boxes in recessed ceilings independent of ceiling tiles and ceiling grid.
7. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for purpose.
8. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
9. Set metal floor boxes level and flush with finished floor surface.
10. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
11. Do not install aluminum boxes, enclosures, or fittings in contact with concrete or earth.
12. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to ensure a continuous ground path.
13. Boxes and Enclosures in Areas or Walls with Acoustical Requirements:
 - a. Seal openings and knockouts in back and sides of boxes and enclosures with acoustically rated putty.
 - b. Provide gaskets for wallplates and covers.
14. Identification: Provide labels for boxes and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
 - c. Label each box with engraved metal or laminated-plastic nameplate.
15. **<Insert more stringent installation requirements that supplement or supersede listed standards and manufacturers' published instructions>.**

D. Interfaces with Other Work:

1. Coordinate installation of new products for **<Insert system or product family/category>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>.**
2. Coordinate with Section 260573.13 "Short-Circuit Studies" for determining available fault current on input feeder.
3. Coordinate with Section 260573.19 "Arc-Flash Hazard Analysis" for determining arc-flash hazard on input feeder.
4. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>.**
 - a. **<Insert requirements for transition between this Section and related Work>.**

3.4 CLEANING

- A. Remove construction dust and debris from boxes before installing wallplates, covers, and hoods.

3.5 PROTECTION

- A. After installation, protect boxes from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.16

SECTION 260533.23 - SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Surface metal raceways and fittings.
 - 2. Surface nonmetallic raceways.
 - 3. Strut-type channel raceways and fittings.
 - 4. Wireways and auxiliary gutters.
- B. Samples:
 - 1. Surface metal raceway nonmetallic cover samples for initial selection.
 - 2. Surface nonmetallic raceway samples for initial selection.
 - 3. Strut-type channel raceway nonmetallic covers for initial selection.
 - 4. Nonmetallic wireway and auxiliary gutter samples for initial selection.
- C. Sustainable design submittals.
 - 1. Surface metal raceways and fittings.
 - 2. Surface nonmetallic raceways.
 - 3. Strut-type channel raceways and fittings.
 - 4. Wireways and auxiliary gutters.

1.3 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Published Instructions:
 - 1. Surface metal raceways and fittings.
 - 2. Surface nonmetallic raceways.
 - 3. Strut-type channel raceways and fittings.
 - 4. Wireways and auxiliary gutters.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 INSTALLATION OF SURFACE RACEWAYS FOR ELECTRICAL SYSTEMS

- A. Comply with manufacturer's published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. Auxiliary Gutters: Article 366 of NFPA 70.

2. Surface Metal Raceway: Article 386 of NFPA 70.
 3. Surface Nonmetallic Raceway: Article 388 of NFPA 70.
 4. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
1. Install surface raceways only where indicated on Drawings.
 2. Install surface raceway with a minimum **2 inch** radius control at bend points.
 3. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding **48 inch** and with no less than two supports per straight raceway section. Support surface raceway in accordance with manufacturer's published instructions. Tape and glue are unacceptable support methods.
 4. Identification: Provide labels for surface raceways and associated electrical equipment.
 - a. Identify field-installed conductors, interconnecting wiring, and components.
 - b. Provide warning signs.
 5. **<Insert more stringent installation requirements that supplement or supersede listed standards and manufacturers' published instructions>.**
- D. Interfaces with Other Work:
1. Coordinate installation of new products for **<Insert system or product family/category>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>.**
 2. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>.**
 - a. **<Insert requirements for transition between this Section and related Work>.**
- 3.2 CLEANING
- A. Remove construction dust and debris from surface raceways before installing covers.
- 3.3 PROTECTION
- A. After installation, protect surface raceways from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 260533.23

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
1. Product Data: For sealants, indicating VOC content.
 2. Laboratory Test Reports: For sealants, indicating compliance with requirements for low-emitting materials.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 INSTALLATION OF SLEEVES FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Sleeves for Conduits Penetrating Above-Grade, Non-Fire-Rated, Concrete and Masonry-Unit Floors and Walls:
1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall or floor so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - b. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 3. Size pipe sleeves to provide [**1/4 inch**] <Insert dimension> annular clear space between sleeve and raceway or cable, unless sleeve-seal system is to be installed[**or seismic criteria require different clearance**].
 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 5. Install sleeves for floor penetrations. Extend sleeves installed in floors [**2 inch**] <Insert dimension> above finished floor level. Install sleeves during erection of floors.
- B. Sleeves for Conduits Penetrating Non-Fire-Rated Wall Assemblies:
1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 2. Seal space outside of sleeves with approved joint compound for wall assemblies.
- C. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- D. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [**steel**] [**cast-iron**] pipe sleeves and mechanical sleeve-seal systems. Size sleeves to allow for **1 inch** annular clear space between pipe and sleeve for installing mechanical sleeve seals.

E. Underground, Exterior-Wall and Floor Penetrations:

1. Install [steel] [cast-iron] pipe sleeves with integral waterstops. Size sleeves to allow for **1 inch** annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Install sleeve during construction of floor or wall.
2. Install steel pipe sleeves. Size sleeves to allow for **1 inch** annular clear space between raceway or cable and sleeve for installing sleeve-seal system. Grout sleeve into wall or floor opening.

END OF SECTION 260544

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous identification products.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Labels.
 - 2. Bands and tubes.
 - 3. Tapes and stencils.
 - 4. Tags.
 - 5. Signs.
 - 6. Cable ties.
 - 7. Miscellaneous identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1[**and IEEE C2**].
- B. Comply with 29 CFR 1910.144 for color identification of hazards; 29 CFR 1910.145 for danger, caution, warning, and safety instruction signs and tags; and the following:
 - 1. Fire-protection[**and fire-alarm**] equipment[, **including raceways**,] must be finished, painted, or suitably marked safety red.
 - 2. Ceiling-mounted hangers, supports, cable trays, and raceways must be finished, painted, or suitably marked safety yellow where less than **[7.7 ft]** **<Insert height>** above finished floor.
- C. Signs, labels, and tags required for personnel safety must comply with the following standards:
 - 1. Safety Colors: NEMA Z535.1.
 - 2. Facility Safety Signs: NEMA Z535.2.
 - 3. Safety Symbols: NEMA Z535.3.
 - 4. Product Safety Signs and Labels: NEMA Z535.4.
 - 5. Safety Tags and Barricade Tapes for Temporary Hazards: NEMA Z535.5.
- D. Comply with **[NFPA 70E]** [and] **[Section 260573.19 "Arc-Flash Hazard Analysis"]** requirements for arc-flash warning labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, must comply with UL 969.

- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: [**120 deg F, ambient; 180 deg F, material surfaces**] <Insert temperature change>.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 1000 V or Less:
1. **[Black letters on orange field]** <Insert color scheme>.
 2. Legend: Indicate voltage[**and system or service type**].
- B. Color-Coding for Phase- and Voltage-Level Identification, 1000 V or Less: Use colors listed below for ungrounded [**service**] [**feeder**] [**and**] [**branch-circuit**] conductors.
1. Color must be factory applied[**or field applied for sizes larger than 8 AWG if authorities having jurisdiction permit**].
 2. Colors for 208Y/120 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 3. Colors for 240 V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 4. Colors for 480Y/277 V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 5. Color for Neutral: [**White**] [**or**] [**gray**].
 6. Color for Equipment Grounds: [**Bare copper**] [**Green**] [**Green with yellow stripe**].
 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 1000 V:
1. Black letters on orange field.
 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- D. Warning Label Colors:
1. Identify system voltage with black letters on orange background.
 2. **<Insert colors>**.
- E. Warning labels and signs must include, but are not limited to, the following legends:
1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
 2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 3 FEET MINIMUM."
 3. **<Insert names and wording of warning signs or labels (for example, arc flash, multiple services and voltages, and others)>**.
- F. Equipment Identification Labels:
1. Black letters on white field.
 2. **<Insert specific requirements for equipment to be labeled, such as transformers,**

panelboards, etc.>.

2.3 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless steel screws or stainless steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 1000 V: Identification must completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. System Identification for Raceways and Cables over 1000 V: Identification must completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- J. Emergency Operating Instruction Signs: Install instruction signs with white legend on red background with minimum **3/8 inch** high letters for emergency instructions at equipment used for **[power transfer] [load shedding] <Insert emergency operations>**.
- K. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for

viewing from floor.

- L. Accessible Fittings for Raceways: Identify cover of junction and pull box of the following systems with wiring system legend and system voltage. System legends must be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
 - 4. **<Insert name>**.
- M. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to location and substrate.
- N. Snap-Around Labels: Secure tight to surface at location with high visibility and accessibility.
- O. Self-Adhesive Wraparound Labels: Secure tight to surface at location with high visibility and accessibility.
- P. Self-Adhesive Labels:
 - 1. Install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide single line of text with **1/2 inch** high letters on **1-1/2 inch** high label; where two lines of text are required, use labels **2 inch** high.
- Q. Snap-Around Color-Coding Bands: Secure tight to surface at location with high visibility and accessibility.
- R. Heat-Shrink, Preprinted Tubes: Secure tight to surface at location with high visibility and accessibility.
- S. Marker Tapes: Secure tight to surface at location with high visibility and accessibility.
- T. Self-Adhesive Vinyl Tape: Secure tight to surface at location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for minimum distance of **6 inch** where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- U. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- V. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's instructions.
- W. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at **6 to 8 inch** below finished grade. Use multiple tapes where width of multiple lines installed in common trench [**or concrete envelope**] exceeds **16 inch** overall.

2. Limit use of underground-line warning tape to direct-buried cables.
 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- X. Metal Tags:
1. Place in location with high visibility and accessibility.
 2. Secure using **[general-purpose]** **[UV-stabilized]** **[plenum-rated]** cable ties.
- Y. Nonmetallic Preprinted Tags:
1. Place in location with high visibility and accessibility.
 2. Secure using **[general-purpose]** **[UV-stabilized]** **[plenum-rated]** cable ties.
- Z. Write-on Tags:
1. Place in location with high visibility and accessibility.
 2. Secure using **[general-purpose]** **[UV-stabilized]** **[plenum-rated]** cable ties.
- AA. Baked-Enamel Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
 2. Unless otherwise indicated, provide single line of text with **1/2 inch** high letters on minimum **1-1/2 inch** high sign; where two lines of text are required, use signs minimum **2 inch** high.
- BB. Metal-Backed Butyrate Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
 2. Unless otherwise indicated, provide single line of text with **1/2 inch** high letters on **1-1/2 inch** high sign; where two lines of text are required, use labels **2 inch** high.
- CC. Laminated Acrylic or Melamine Plastic Signs:
1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to location and substrate.
 2. Unless otherwise indicated, provide single line of text with **1/2 inch** high letters on **1-1/2 inch** high sign; where two lines of text are required, use labels **2 inch** high.
- DD. Cable Ties: General purpose, for attaching tags, except as listed below:
1. Outdoors: UV-stabilized nylon.
 2. In Spaces Handling Environmental Air: Plenum rated.
- 3.3 IDENTIFICATION SCHEDULE
- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 1000 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with **3 inch** high, black letters on **20 inch** centers.
1. Locate identification at changes in direction, at penetrations of walls and floors, and at

[10 ft] [30 ft] maximum intervals.

- D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 1000 V: **[Vinyl wraparound labels] [Snap-around labels] [Self-adhesive labels] [Snap-around color-coding bands for raceway and cables]**.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at **50 ft** maximum intervals in straight runs, and at **25 ft** maximum intervals in congested areas.
- E. Accessible Raceways and Metal-Clad Cables, 1000 V or Less, for Service, Feeder, and Branch Circuits, More Than **[30] <Insert number> A** and **[120] <Insert number> V** to Ground: Identify with self-adhesive **[raceway labels] [vinyl tape applied in bands]**.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at **50 ft** maximum intervals in straight runs, and at **25 ft** maximum intervals in congested areas.
- F. Accessible Fittings for Raceways and Cables within Buildings: Identify cover of junction and pull box of the following systems with self-adhesive labels containing wiring system legend and system voltage. System legends must be as follows:
 - 1. "EMERGENCY POWER."
 - 2. "POWER."
 - 3. "UPS."
 - 4. **<Insert name>**.
- G. Power-Circuit Conductor Identification, 1000 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use **[vinyl wraparound labels] [self-adhesive wraparound labels] [snap-around labels] [snap-around color-coding bands] [self-adhesive vinyl tape]** to identify phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at **50 ft** maximum intervals in straight runs, and at **25 ft** maximum intervals in congested areas.
- H. Power-Circuit Conductor Identification, More Than 1000 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use **[write-on tags] [nonmetallic preprinted tags colored and marked to indicate phase, and separate tag with circuit designation]**.
- I. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use **[write-on tags] [self-adhesive labels]** with conductor or cable designation, origin, and destination.
- J. Control-Circuit Conductor Termination Identification: For identification at terminations, provide **[heat-shrink preprinted tubes] [self-adhesive labels]** with conductor designation.
- K. Conductors to Be Extended in Future: Attach **[write-on tags] [marker tape]** to conductors **[and list source]**.
- L. Auxiliary Electrical Systems Conductor Identification: **[Marker tape] [Self-adhesive vinyl tape]** that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- M. Locations of Underground Lines: Underground-line warning tape for power, lighting,

communication, and control wiring and optical-fiber cable.

- N. Concealed Raceways and Duct Banks, More Than 1000 V, within Buildings: Apply floor marking tape to the following finished surfaces:
1. Floor surface directly above conduits running beneath and within **12 inch** of floor that is in contact with earth or is framed above unexcavated space.
 2. Wall surfaces directly external to raceways concealed within wall.
 3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in building, or concealed above suspended ceilings.
- O. Workspace Indication: Apply [**floor marking tape**] [**or**] [**tape and stencil**] to finished surfaces. Show working clearances in direction of access to live parts. Workspace must comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- P. Instructional Signs: Self-adhesive labels, including color code for grounded and ungrounded conductors.
- Q. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: [**Self-adhesive labels**] [**Baked-enamel warning signs**] [**Metal-backed, butyrate warning signs**].
1. Apply to exterior of door, cover, or other access.
 2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:
 - a. Power-transfer switches.
 - b. Controls with external control power connections.
 - c. **<Insert items>**.
- R. Arc Flash Warning Labeling: Self-adhesive labels.
- S. Operating Instruction Signs: [**Self-adhesive labels**] [**Baked-enamel warning signs**] [**Metal-backed, butyrate warning signs**] [**Laminated acrylic or melamine plastic signs**].
- T. Emergency Operating Instruction Signs: [**Self-adhesive labels**] [**Baked-enamel warning signs**] [**Metal-backed, butyrate warning signs**] [**Laminated acrylic or melamine plastic signs**] with white legend on red background with minimum **3/8 inch** high letters for emergency instructions at equipment used for [**power transfer**] [**load shedding**] **<Insert emergency operations>**.
- U. Equipment Identification Labels:
1. Indoor Equipment: [**Self-adhesive label**] [**Baked-enamel signs**] [**Metal-backed butyrate signs**] [**Laminated acrylic or melamine plastic sign**].
 2. Outdoor Equipment: [**Laminated acrylic or melamine sign**] [**Stenciled legend 4 inch high**].
 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in location provided by panelboard manufacturer. Panelboard identification must be in form of [**self-adhesive, engraved,**] [**engraved,**] laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.

- d. Switchgear.
- e. Switchboards.
- f. Transformers: Label that includes tag designation indicated on Drawings for transformer, feeder, and panelboards or equipment supplied by secondary.
- g. Substations.
- h. Emergency system boxes and enclosures.
- i. Motor-control centers.
- j. Enclosed switches.
- k. Enclosed circuit breakers.
- l. Enclosed controllers.
- m. Variable-speed controllers.
- n. Push-button stations.
- o. Power-transfer equipment.
- p. Contactors.
- q. Remote-controlled switches, dimmer modules, and control devices.
- r. Battery-inverter units.
- s. Battery racks.
- t. Power-generating units.
- u. Monitoring and control equipment.
- v. UPS equipment.
- w. <Insert equipment>.

END OF SECTION 260553

SECTION 260913 - ELECTRICAL POWER MONITORING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. PC operating system software.
 - 2. Networked PC operating system software.
 - 3. Power monitoring and control software.
 - 4. Network configuration software.
 - 5. Monitoring and control of power distribution equipment.
 - 6. System operator interfaces.
 - 7. Raceways and boxes.
 - 8. Wires and cables.

1.2 DEFINITIONS

- A. Active Power: The average power consumed by a unit. Also known as "real power."
- B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
- C. Apparent (Phasor) Power: " $S = VI$ " where "S" is the apparent power, "V" is the RMS value of the voltage, and "I" is the RMS value of the current.
- D. Firmware: Software (programs or data) that has been written onto read-only memory (ROM). Firmware is a combination of software and hardware. Storage media with ROMs that have data or programs recorded on them are firmware.
- E. KY Pulse: A method of measuring consumption of electricity that is based on a relay operating like a SPST switch.
- F. KYZ Pulse: A method of measuring consumption of electricity based on a relay operating like a SPDT switch.
- G. L-G: Line to ground.
- H. L-L: Line to line.
- I. L-N: Line to neutral.
- J. MODBUS TCP/IP: An open protocol for exchange of process data.
- K. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.
- L. N-G: Neutral to ground.
- M. Power Factor: The ratio of active power to apparent power, sometimes expressed in percentage.

1.3 ACTION SUBMITTALS

- A. Product Data:

1. Multifunction energy meters.
 2. Power meters.
 3. Circuit meters and monitors.
 4. Circuit meter and explorer.
 5. PC operating system software.
 6. Networked PC operating system software.
 7. Power monitoring and control software.
 8. Network configuration software.
 9. Monitoring and control of power distribution equipment.
 10. System operator interfaces.
 11. Desktop workstations.
 12. Portable workstations.
 13. Raceways and boxes.
 14. Wires and cables.
 15. Surge protection devices.
- B. Sustainable Design Submittals:
1. Product Data: Indicating that computers used by the system are certified by ENERGY STAR.
- C. Shop Drawings: For power monitoring and control equipment.
1. Include plans, elevations, sections, and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, method of field assembly, components, and location and size of each field connection.
 - a. Attach copies of approved Product Data submittals for products (such as switchboards, switchgear, and motor-control centers) that describe the following:
 - 1) Location of the meters and gateways, and routing of the connecting wiring.
 - 2) Details of power monitoring and control features to illustrate coordination among related equipment and power monitoring and control.
 3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.
 4. Network naming and numbering scheme.
 5. Include diagrams for power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.
 6. Specifications for workstations.
 7. UPS sizing calculations for workstation.
 8. Surge Suppressors: Data for each device used and where applied.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Field quality-control reports.
- B. Design Data:
1. Manufacturer's system installation and setup guides, with data forms to plan and record options and setup decisions.
 - a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format on compact disk or portable storage device with a USB interface.

- b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
- c. As-built versions of submittal Product Data.
- d. Names, addresses, e-mail addresses, and 24-hour telephone numbers of Installer and service representatives for the system and products.
- e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing set points and variables.
- f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
- g. Engineering, installation, and maintenance manuals that explain how to do the following:
 - 1) Design and install new points, panels, and other hardware.
 - 2) Perform preventive maintenance and calibration.
 - 3) Debug hardware problems.
 - 4) Repair or replace hardware.
- h. Documentation of programs created using custom programming language including set points, tuning parameters, and object database.
- i. Backup copy of graphic files, programs, and database on compact disk or portable storage device with a USB interface.
- j. Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
- k. Complete original-issue copies of furnished software, including operating systems, custom programming language, workstation software, and graphics software on compact disk or portable storage device with a USB interface.
- l. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
- m. Owner training materials.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Addressable Relays: One for every [10] <Insert number> installed. Furnish at least one of each type.
 - 2. Data Line Surge Suppressors: One for every [10] <Insert number> of each type installed. Furnish at least one of each type.
 - 3. <Insert material>.

1.6 COORDINATION

- A. Coordinate features of distribution equipment and power monitoring and control components to form an integrated interconnection of compatible components.
 - 1. Match components and interconnections for optimum performance of specified functions.
- B. Coordinate Work of this Section with those in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Microprocessor-based monitoring and control of electrical power distribution system(s) that includes the following:
 - 1. Electrical meters that monitor, control, and connect to the data transmission network.
 - 2. LAN: High-speed, multi-access, open, nonproprietary, industry-standard communication protocols.
 - 3. Include **[PC-based workstation] [multiple PC-based workstations] [with web access]**, with its operating system and application software, connected to data transmission network.
- B. The electrical power monitoring and control system must be Internet based.
 - 1. System software must be based on server thin-client architecture, designed around open standards of internet technology.
 - 2. Intent of thin-client architecture is to provide operators complete access to power monitoring and control system via an Internet browser. No special software other than an Internet browser must be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.
 - 3. Internet access must be password protected.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with UL 61010-1 and marked for intended location and application.

2.2 PERFORMANCE REQUIREMENTS

- A. Surge Protection: For external wiring of each conductor entry connection to components to protect components from voltage surges originating external to equipment housing and entering through power, communication, signal, control, or sensing leads.
 - 1. Minimum Protection for Power Lines 120 V and More: **[SPDs complying with UL 1449, listed and labeled for intended use by an NRTL acceptable to authorities having jurisdiction.] [Auxiliary panel suppressors complying with requirements in Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."]**
 - 2. Minimum Protection for Communication, Signal, Control, and Low-Voltage Power Lines: Comply with requirements as recommended by manufacturer for type of line being protected.
- B. Addressable Devices: Transmitters and receivers must communicate unique device identification and status reports to monitoring and control clients.
- C. Interface with DDC System for HVAC: Provide factory-installed hardware and software to enable the DDC system for HVAC to monitor, display, and record data for use in processing reports.
 - 1. Hardwired Monitoring Points: Electrical power demand (kilowatts), electrical power consumption (kilowatt-hours)[, **power factor**] **<Insert monitoring point>**.
 - 2. **[ASHRAE 135 (BACnet)] [ISO/IEC 14908-1 (LonTalk)] [MODBUS Application Protocol Specification] [Industry-accepted, open-protocol] <Insert type of interface>** communication interface with the DDC system for HVAC must enable the DDC system for HVAC operator to remotely monitor meter information from a DDC system for HVAC workstation. Control features and monitoring points displayed locally at metering panel must be available through the DDC system for HVAC.

D. Backup Power Source:

1. Electrical power distribution equipment served by a backup power source for controls must have associated power monitoring and control system products that monitor and control such systems and equipment also served from a backup power source.

2.3 PC OPERATING SYSTEM SOFTWARE

A. Description: System software must monitor, analyze, display, control, and save the parameters and features available at the connected meter.

B. Software: Configured to run on a portable laptop computer, a single PC, or a tablet computer, with capability for accessing a single meter at a time, at the location of the meter. System is not connected to LAN.

C. Minimum Requirements:

1. Real-time multitasking and multiuser [32-] [or] [64-]bit operating system that allows execution of multiple real-time programs and custom program development.
2. Operating system must be capable of operating Microsoft Windows applications.
3. Scheduling software must schedule centrally based time and event, temporary, and exception day programs.

2.4 NETWORKED PC OPERATING SYSTEM SOFTWARE

A. Description: System software must monitor, analyze, display, control, and save parameters and features available at each of the connected meters.

B. Software: Configured to run on a single PC, with capability for accessing multiple devices simultaneously. Software must include interactive graphics client and must be web enabled.

C. System Software Minimum Requirements:

1. Real-time multitasking and multiuser [32-] [or] [64-]bit operating system that allows concurrent multiple workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system must be capable of operating Microsoft Windows applications.
3. Database management software must manage data on an integrated and non-redundant basis. Additions and deletions to database must be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Scheduling software must schedule centrally based time and event, temporary, and exception day programs.

D. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device, touchscreen, or mouse.
3. Operator sign-off must be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period must be programmable from 1 to 60 minutes in 1-minute increments on a per operator basis.
5. Record operator sign-on and sign-off activity.

6. Security Access:
 - a. Operator access to electrical monitoring and control system must be under password control.
 - b. An alphanumeric password must be user assignable to each operator.
 - c. Software must have at least five access levels.
 - 1) View - View information. No change privileges allowed.
 - 2) User - Same as View, but is able to initiate control functions.
 - 3) Controller - Same as User, but is able to initiate communications.
 - 4) Operator - Same as Controller, but is able to modify configurations.
 - 5) Supervisor - Same as Operator, but is able to administer security privileges.
 - d. Each menu item must be assigned an access level so that a one-for-one correspondence between operator-assigned access level(s) and menu-item access level(s) is required to gain access to menu item.
 - e. Display menu items to operator with those menu items capable of access highlighted. Menu and operator access level assignments must be online programmable and under password control.

E. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system data to operator.
2. Descriptors for graphics, points, alarms, and such must be modified through workstation under password control.
3. Display operator accessed data on the monitor.
4. Help Features: On-line context-sensitive help utility to facilitate operator training and understanding.

2.5 POWER MONITORING AND CONTROL SOFTWARE

A. Data Storage and Data Sharing:

1. Query and download logs of interval data stored on metering devices.
2. Query and download logs of alarm and event data stored on metering devices.
3. Query and download logs of waveform capture data stored on metering devices.
4. Query and download logs of interval data generated by the software and calculated by the meters.
5. Query and download logs of alarm and event data generated by the software and calculated by the meters.
6. Automatically re-arm the waveform recorders, on upload of information.
7. Provide a facility to archive, trim, and back up the database on demand, or on a schedule.
8. Provide a facility to view historical data from archived databases.
9. Support user changes to the database.
 - a. Support on-line changes while the data storage/retrieval application is running.
 - b. Suffer no interruption to its operation while changes are being made.
 - c. Require no restart once the configuration has been performed.

B. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by the electrical power monitoring and control system.
2. Plan for each building floor, showing the following:
 - a. Locations and identification of monitored and controlled electrical equipment.
 - b. **<Insert requirements>**.
3. Control schematic for each device that is controlled by the meters of this Section,

- including a graphic system schematic representation[, **similar to that indicated on Drawings,**] with device identification.
4. Graphic display for each piece of equipment connected to the electrical monitoring and control system through a data link.
 5. Electrical power monitoring and control system network riser diagram that shows schematic layout for entire system including meters, **[gateways] [and] [other network devices]**.

2.6 NETWORK CONFIGURATION SOFTWARE

A. Network Management Graphical Interface Features:

1. Add and remove devices in the power monitoring and control network.
2. Application for naming devices based on a user-defined naming scheme.
3. Add and remove I/O servers in the power monitoring and control network.
4. Edit communication properties for devices including timeouts and delays.
5. Display mandatory fields when adding a new device.
6. Allow to manually connect and disconnect serial, Ethernet, modem, and Ethernet gateway sites.
7. Enable and disable devices and sites in the power monitoring and control network without interruption to other devices or sites.
8. Pool modem resources so that the software uses any available modem.
9. Monitor the following diagnostics:
 - a. Communication request/response and error rates, and timeouts.
 - b. Log acquisition services.

B. Database Maintenance Features:

1. Backup, archive, and trim data, event, and waveform logs.
 - a. Record start and end date for operation.
 - b. Allow copying data to another database.
 - c. Be capable of selecting logs specified for the meters that are Work of this Section.
 - 1) Data logs.
 - 2) Event logs.
 - 3) Waveform logs.

C. Web Reporter: Allow viewing historical data in preformatted report templates via a web browser.

1. Features:
 - a. User-configurable report generator to trigger on event, based on a schedule, or manual initiation.
 - b. Format reports in HTML, PDF, TIF, Excel, XML, or user-selected printer, or network folder.
 - c. Distribution of reports via email.
2. Report on power and demand profiles.
3. Power quality report with CBEMA evaluation.
4. EN 50160 compliance report.
5. 100 ms PQ report.
6. Energy over Period Report:
 - a. User-defined rollup interval by day, week, month, or year.
 - b. Compare daily energy to the following:
 - 1) Previous day.
 - 2) Same day, previous week.

- 3) Same day, previous month.
 - 4) User-defined specific day.
 - c. Compare weekly energy to the following:
 - 1) Previous week.
 - 2) Same week from previous month.
 - 3) Same week from previous year.
 - 4) User-defined specific week.
 - d. Compare monthly energy to the following:
 - 1) Previous month.
 - 2) Same month from previous year.
 - 3) User-defined specific month.
 - e. Compare annual energy to the following:
 - 1) Previous year.
 - 2) User-defined specific year.
- 7. Energy by daily period report for the user-defined periods. Aggregate consumption of the periods by the day, week, and year.
- 8. Tabular Report: Show values for multiple measurements and measurements from multiple devices in tabular format.
- 9. Trend Report:
 - a. Show values for multiple measurements and measurements from multiple devices in the following graphical formats:
 - 1) Line chart.
 - 2) Pie graph.
 - 3) Bar chart.
 - 4) Column chart.
 - 5) Smooth line chart.
 - 6) Stacked column chart.
 - 7) Stacked bar chart.
- 10. Alarm and Event History: User formatted, based on the meters and priority; and with user-defined alarm and event reports.
- 11. System Configuration Report:
 - a. Device name.
 - b. Device type.
 - c. Device address.
 - d. Connection status.
 - e. Device protocol.
 - f. Device description.
- 12. Each default report must include the following:
 - a. Summary aggregation of data from the selected devices.
 - b. Individual device information.
 - c. Raw data.
- 13. The reporting tool must provide a graphical interface to create and manage multiple Time of Use schedules:
 - a. Tariffs including energy cost rates per kWh, kVARh, and kVAh, and demand charges per kW, kVAR, and kVA.
 - b. Off-peak and on-peak times.

2.7 MONITORING AND CONTROL OF POWER DISTRIBUTION EQUIPMENT

- A. Power Distribution Equipment: Web-enabled, direct connected to the LAN or intranet.

- B. Instrument Transformers: Comply with IEEE C57.13.
 - 1. Potential Transformers: Secondary voltage rating of 120 V and NEMA C12.11 accuracy class of 0.3 with burdens of W, X, and Y.
 - 2. Current Transformers: Burden and accuracy class suitable for connected relays, meters, and instruments.
- C. Ethernet Connectivity:
 - 1. A multipoint, MODBUS TIA-485 serial communications network must be included within the equipment to interconnect breaker trip units, protective relays, drives, and metering devices equipped with communications.
 - 2. Serial communications network must be wired to an Ethernet server in the incoming section of the equipment. Hardware and cabling required for the connection to the network must be included within the power distribution equipment.
 - 3. Serial communications devices within the equipment must be factory addressed and tested to verify reliable communications to the equipment's Ethernet Server.
- D. Ethernet Gateways:
 - 1. User configurable; complying with UL 60950-1, and IEEE 802.3, Class 3 PoE.
 - 2. Include provisions to set initial Ethernet parameters via a local operator interface, or standard (8PSJ) Ethernet port, that is accessible from the front of the equipment. Initial setup must be limited to basic Ethernet addressing parameters, as assigned by Owner.
 - 3. Common Gateway Features:
 - a. User configurable, with secure password-protected login process.
 - b. Include communications diagnostic information for serial and Ethernet ports as well as internal health status and memory management information through embedded HTML web pages for viewing using a standard web browser.
 - c. Include embedded HTML pages providing real-time information from devices connected to the Ethernet gateway's TIA-485 port(s) through a standard web browser.
 - d. Allow firmware upgrades through the communications port.
 - 4. Include a "Quick-Start" guide with the equipment to describe the commissioning process for setting the equipment's Ethernet network address and for ensuring trouble-free data access from any PC on the network, using a standard web browser.
 - 5. Implement a common user interface ("look and feel") across different styles of power equipment.
- E. Distribution Equipment Monitoring:
 - 1. Main menu and summary pages, factory configured, to display data for each communicating device within the power equipment lineup.
 - 2. Display Data:
 - a. Circuit summary page to display circuit name, three-phase average RMS current, real power (kW), power factor, and breaker status (if applicable).
 - b. Load current summary page to display circuit name, and phase a, b, and c RMS current values.
 - c. Demand current summary page to display circuit name, and phase a, b, and c average demand current values.
 - d. Power summary page to display circuit name, present demand power (kW), peak demand power (kW), and recorded time and date.
 - e. Energy summary page to display circuit name, real energy (kWh), reactive energy

- (kVARh), and time/date of last reset.
- f. For unit substations equipped with dry-type transformer(s) and microbased temperature controller(s), the circuit summary web page listed above must be augmented with transformer coil temperatures, phase a, b and c current values, and cooling fan status (on/off).
- g. For motor-control centers, the circuit summary web page must be tailored specifically for this application, to display circuit name, three-phase average RMS current, thermal capacity (percentage), drive output frequency (in Hertz, where applicable), and contactor status.

2.8 SYSTEM OPERATOR INTERFACES

- A. Operator means of system access must be through the following:
 - 1. Desktop workstation with hardwired connection through LAN port.
 - 2. Portable terminal with hardwired connection through LAN port at each meter.
 - 3. Remote connection using outside of system PC, tablet, or phone using an internet portal.

2.9 RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533.13 "Conduits for Electrical Systems" for raceways for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.
- B. Comply with requirements in Section 270528 "Pathways for Communications Systems" for control wiring, TIA-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.

2.10 WIRES AND CABLES

- A. Electrical Power Wiring: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - 1. Copper conductors are Type THHN/THWN-2.
- B. Control Wiring: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
 - 1. Optical-Fiber Cable: Multimode, 50/125 micrometer OM3, six-fiber, **[nonconductive]**, tight-buffer, optical-fiber cable, with aqua jacket.
 - 2. Balanced Twisted Pair Cable: 100 ohm, four-pair **[Category 5e]** **[Category 6]**.
 - 3. Workstation Outlets: Four-port-connector assemblies mounted in single or multigang faceplate. Coordinate color and labels with Section 262726 "Wiring Devices."
 - 4. TIA-485 Cable: Paired, **[one pair]** **[two pairs]**, twisted, No. 22 AWG, stranded (7x30) tinned-copper conductors.
 - 5. Control-Voltage Control Cable: Multiple conductor, color-coded, No. 20 AWG copper, minimum.
 - a. Sheath: PVC; except in plenum-type spaces, use sheath listed for plenums.
 - b. Ordinary Switching Circuits: Three conductors unless otherwise indicated.
 - c. Switching Circuits with Pilot Lights or Locator Feature: Five conductors unless otherwise indicated.
- C. TIA-232 Cable:
 - 1. PVC-Jacketed, TIA-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, polypropylene insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; PVC jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.

- a. Type CM.
- b. Flame Resistance: UL 1581, vertical tray.
- 2. Plenum-Type, TIA-232 Cable: Paired, two pairs, No. 22 AWG, stranded (7x30) tinned copper conductors, plastic insulation, and individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage; plastic jacket. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
 - a. Type CMP.
 - b. Flame Resistance: NFPA 262, flame test.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine pathway elements intended for cables. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF POWER MONITORING AND CONTROL SYSTEMS

- A. Wiring Method: Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters. Conceal raceway and cables except in unfinished spaces.
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- C. Wiring and Cabling Installation:
 - 1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
 - 2. Comply with Section 260523 "Control-Voltage Electrical Power Cables" for control wiring.
- D. Raceways Installation:
 - 1. Comply with Section 260533.13 "Conduits for Electrical Systems" for electrical power wiring and NFPA 70 Class 1 remote-control and signaling circuits.
 - 2. Comply with Section 270528 "Pathways for Communications Systems" for control wiring, TIA-232 cable, and NFPA 70 Class 2 remote-control and signaling circuits.
- E. Identification Installation:
 - 1. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power wiring.
 - 2. Comply with Section 271513 "Communications Copper Horizontal Cabling" for identification products and cable management system requirements for twisted pair cable, TIA-485 cable, control-voltage cable, and TIA-232 cable.
 - 3. Comply with Section 271523 "Communications Optical Fiber Horizontal Cabling" for identification products and cable management system requirements for optical-fiber cable.

3.3 INSTALLATION OF WORKSTATIONS

- A. Desktop Workstations Installation:
 - 1. Install workstation(s) at location(s) directed by Owner.

2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single, duplex electrical power receptacle.
 3. Install software on workstation(s) and verify that software functions properly.
 4. Develop Project-specific graphics, trends, reports, logs, and historical database.
 5. Power workstation through a UPS unit. Locate UPS adjacent to workstation.
- B. Portable Workstations Installation:
1. Turn over portable workstations to Owner at Substantial Completion.
 2. Install software on workstation(s) and verify that software functions properly.
- C. Graphics Application:
1. Use system schematics indicated as starting point to create graphics.
 2. Develop Project-specific library of symbols for representing system equipment and products.
 3. Incorporate digital images of Project-completed installation into graphics where beneficial to enhance effect.
 4. Submit sketch of graphic layout with description of text for each graphic for Owner's[**and Architect's**] review before creating graphic using graphics software.
 5. Seek Owner input in graphics development once using graphics software.
 6. Final editing must be done on-site with Owner's review and feedback.
 7. Refine graphics as necessary for Owner acceptance.
 8. On receiving Owner acceptance, print a hard copy to include in operation and maintenance manual. Prepare a scanned copy PDF file of each graphic and include with softcopy of the system operation and maintenance manual.
- 3.4 NETWORK NAMING AND NUMBERING
- A. Coordinate with Owner and provide unique naming and addressing for networks and devices.
- 3.5 GROUNDING
- A. For data communication wiring, comply with BICSI N1.
- B. For control-voltage wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."
- 3.6 FIELD QUALITY CONTROL
- A. Field tests and inspections must be witnessed by [**Architect**] [**Tenant**] [**authorities having jurisdiction**] <Insert names or titles of witnesses>.
- B. Tests and Inspections:
1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 2. Visually inspect balanced twisted pair cabling and optical-fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA-568-C.1.
 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of components.
 4. Test balanced twisted pair cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.

- a. Test instruments must meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- b. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- 5. Optical-Fiber Cable Tests:
 - a. Test instruments must meet or exceed applicable requirements in TIA-568-C.0. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
 - b. Link End-to-End Attenuation Tests:
 - 1) Multimode Link Measurements: Test at 850 or 1300 nm in one direction according to IEC 61280-4-1.
 - 2) Attenuation test results for links must be less than **[2.0 dB] [that calculated according to equation in TIA-568-C.0]**.
 - c. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- 6. Power Monitoring and Control System Tests.
 - a. Test Analog Signals:
 - 1) Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
 - 2) Check analog current signals using a precision current meter at zero, 50, and 100 percent.
 - 3) Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.
 - b. Test Digital Signals:
 - 1) Check digital signals using a jumper wire.
 - 2) Check digital signals using an ohmmeter to test for contact making or breaking.
 - c. I/O Control Loop Tests:
 - 1) Test every I/O point to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
 - 2) Test every I/O point throughout its full operating range.
 - 3) Test every control loop to verify that operation is stable and accurate.
 - 4) Adjust control loop proportional, integral, and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
 - 5) Test and adjust every control loop for proper operation according to sequence of operation.
 - 6) Test software and hardware interlocks for proper operation.
 - 7) Operate each analog point at the following:
 - a) Upper quarter of range.
 - b) Lower quarter of range.

- c) At midpoint of range.
- 8) Exercise each binary point.
- 9) For every I/O point in the system, read and record each value at workstation, at controller, and at field instrument simultaneously. Value displayed at workstation and at field instrument must match.
- 10) Prepare and submit a report documenting results for each I/O point in the system, and include in each I/O point a description of corrective measures and adjustments made to achieve desired results.

C. Nonconforming Work:

- 1. Wiring and cabling will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.7 FINAL REVIEW

A. Submit written request to Architect **[and]** **[Construction Manager]** when the power monitoring and control system is ready for final review. Written request must state the following:

- 1. The system has been thoroughly inspected for compliance with Contract Documents and found to be in full compliance.
- 2. The system has been calibrated, adjusted, and tested and found to comply with requirements of operational stability, accuracy, speed, and other performance requirements indicated.
- 3. The system monitoring and control of electrical distribution systems results in operation according to sequences of operation indicated.
- 4. The system is complete and ready for final review.

B. Review by **[Architect]** **[and]** **[Construction Manager]** will be made after receipt of written request. A field report must be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Final review must include a demonstration to parties participating in final review.

3.8 MAINTENANCE SERVICE

A. Beginning at Substantial Completion, maintenance service must include **[three]** **[six]** **[nine]** **[12]** months' full maintenance by manufacturer's authorized service representative. Include **[quarterly]** **[semiannual]** **[annual]** preventive maintenance, repair or replacement of defective components, cleaning, and adjusting as required for proper system operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

3.9 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement must include software support for **[two]** **<Insert number>** years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within **[two]** **<Insert number>** years from date of Substantial Completion. Upgrading software must include operating system and new or

revised licenses for using software.

1. Upgrade Notice: At least [30] <Insert number> days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.10 TRAINING

A. Attendee Training Manuals:

1. Provide each attendee with a color hard copy of training materials and visual presentations.
2. Hard-copy materials must be organized in a three-ring binder with table of contents and individual divider tabs marked for each logical grouping of subject matter. Organize material to provide space for attendees to take handwritten notes within training manuals.
3. In addition to hard-copy materials included in training manual, provide each binder with a sleeve or pocket that includes a DVD or flash drive with PDF copy of hard-copy materials.

B. On-Site Training:

1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power, and data connectivity for instructor and each attendee.
2. Instructor must provide training materials, projector, and other audiovisual equipment used in training.
3. Provide as much of training located on-site as deemed feasible and practical by Owner.
4. On-site training must include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration, and service requirements.
5. The workstation provided with the system must be used in training. If workstation is not indicated, provide a temporary workstation to convey training content.

C. Off-Site Training:

1. Provide conditioned training rooms and workspace with ample tables, chairs, power, and data connectivity for each attendee.
2. Provide capability to remotely access to Project monitoring and control system for use in training.
3. Provide a workstation for use by each attendee.

D. At Completion of Training: Staff familiar with the system installed are capable of demonstrating operation of the system during final review.

E. Demonstration must include, but not be limited to, the following:

1. Accuracy and calibration of [10] <Insert number> I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.
2. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and workstations.
3. Trends, summaries, logs, and reports set-up for Project.
4. Software's ability to communicate with controllers, workstations, and uploading and downloading of control programs.
5. Software's ability to edit control programs off-line.

6. Data entry to show Project-specific customizing capability including parameter changes.
7. Step through penetration tree, display graphics, demonstrate dynamic update, and direct access to graphics.
8. Execution of digital and analog commands in graphic mode.
9. Spreadsheet and curve plot software and its integration with database.
10. Online user guide and help functions.
11. For Each Meter:
 - a. Memory: Programmed data, parameters, trend, and alarm history collected during normal operation is not lost during power failure.
 - b. Operator Interface: Ability to connect directly to each meter with a portable workstation.
 - c. Wiring Labels: Match control drawings.
 - d. Network Communication: Ability to locate a meter on the network. Communication architecture matches Shop Drawings.
 - e. Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators, and devices.
12. For Each Workstation:
 - a. I/O point lists agree with naming conventions.
 - b. Graphics are complete.
 - c. UPS unit, if applicable, operates.

END OF SECTION 260913

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electronic dial-time switches.
 - 2. Conductors and cables.

1.2 ACTION SUBMITTALS

- A. Product Data:
 - 1. Electronic dial-time switches.
 - 2. Electromechanical dial-time switches.
 - 3. Outdoor photoelectric switches, solid state, flexible mounting.
 - 4. Outdoor photoelectric switches, solid state, luminaire-mounted.
 - 5. Outdoor photoelectric switches, low voltage.
 - 6. Daylight-harvesting switching controls.
 - 7. Daylight-harvesting dimming controls, analog.
 - 8. Daylight-harvesting dimming controls, digital.
 - 9. Indoor occupancy and vacancy sensors.
 - 10. Switchbox-mounted occupancy sensors.
 - 11. Digital timer light switch.
 - 12. High-bay occupancy sensors.
 - 13. Extreme-temperature occupancy sensors.
 - 14. Outdoor motion sensors.
 - 15. Lighting contactors.
 - 16. Emergency shunt relay.
 - 17. Conductors and cables.
- B. Shop Drawings:
 - 1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
 - 2. Interconnection diagrams showing field-installed wiring.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Field quality-control reports.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For manufacturer's warranties.

1.4 WARRANTY

- A. Special Extended Warranty: Manufacturer and Installer warrant that installed lighting control devices perform in accordance with specified requirements and agree to repair or replace, including labor, materials, and equipment, devices that fail to perform as specified within extended warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - c. **<Insert failure modes>.**

2. Extended Warranty Period: [**Two**] [**Three**] [**Four**] <Insert number> year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than [**No. 18**] [**No. 22**] [**No. 24**] AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than [**No. 14**] [**No. 16**] [**No. 18**] AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF SENSORS

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's instructions.

3.3 INSTALLATION OF CONTACTORS

- A. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 INSTALLATION OF WIRING

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is **1/2 inch**.
- B. Wiring within Enclosures: Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.

- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring in accordance with Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by **[Architect] [Tenant] [authorities having jurisdiction]** **<Insert names or titles of witnesses>**.
- B. Tests and Inspections:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Nonconforming Work:
 - 1. Lighting control devices will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Prepare test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to **[support] [supervise]** field tests and inspections.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within **[12] <Insert number>** months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to **[two] <Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 MAINTENANCE

- A. Software and Firmware Service Agreement:
 - 1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for **[two] <Insert number>** years.
 - 2. Upgrade Service: At Substantial Completion, update software and firmware to latest

version. Install and program software upgrades that become available within [two] <Insert number> years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.

- a. Upgrade Notice: No fewer than [30] <Insert number> days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 260923

SECTION 260936 - MODULAR DIMMING CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall-box multiscene dimming controls.
 - 2. Multipreset modular dimming controls.
 - 3. Conductors and cables.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. Fade Rate: The time it takes each zone to arrive at the next scene, dependent on the degree of change in lighting level.
- B. Scene: The lighting effect created by adjusting several zones of lighting to the desired intensity.
- C. SCR: Silicon-controlled rectifier.
- D. Zone: A luminaire or group of luminaires controlled simultaneously as a single entity. Also known as a "channel."

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Wall-box multiscene dimming controls.
 - 2. Multipreset modular dimming controls.
 - 3. Conductors and cables.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on Project. Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
 - 1. Include elevation views of front panels of control and indicating devices and control stations.
 - 2. Include diagrams for power, signal, and control wiring.
 - 3. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
 - 4. Point List and Data Bus Load: Summary list of control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
 - 5. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
 - 6. Block Diagram: Show interconnections between components specified in this Section and

devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

7. Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in [Section 230923 "Direct Digital Control (DDC) System for HVAC"] <Insert Section number and title>.
 - a. Show interconnecting signal and control wiring, and interface devices that show compatibility of inputs and outputs.
 - b. For control interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.

C. Samples for Initial Selection: For master- and remote-control stations, and cover plates with factory-applied color finishes and technical features.

D. Samples for Verification: For master- and remote-control stations, and cover plates with factory-applied color finishes and technical features.

E. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that components of modular dimming controls perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: [Two] [Three] [Four] <Insert number> year(s) from date of Substantial Completion, for labor, materials, and equipment.
2. Follow-on Extended Warranty Period: [Eight] <Insert number> year(s) from date of Substantial Completion, for materials that failed because of transient voltage surges only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Compatibility:

1. Dimming control components must be compatible with [luminaires] [luminaires and ballasts] [luminaires, ballasts, and transformers].
2. Dimming control devices must be compatible with lighting control system components specified in Section 260943.16 "Addressable Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls," and in Section 260923 "Lighting Control Devices."

B. Dimmers and Dimmer Modules: Comply with UL 508.

1. Audible Noise and RFI Suppression: Solid-state dimmers must operate smoothly over their operating ranges without audible lamp or dimmer noise or RFI. Modules must include integral or external filters to suppress audible noise and RFI.
2. Dimmer or Dimmer-Module Rating: Not less than 125 percent of connected load unless

otherwise indicated.

- C. Capacities: Unit must be rated for **[2400 W at 240 V(ac) and 2000 W at 120 V(ac)]** <Insert value> for up to **[100]** <Insert number> devices or zones.
- D. Surge Protection: Withstand supply power surges without impairment to performance.
 - 1. Panels: 6000 V, 3000 A, complying with IEEE C62.41.1 and IEEE C62.41.2.
 - 2. Other System Devices: 6000 V, 3000 A, complying with IEEE C62.41.1 and IEEE C62.41.2.
- E. Off Control Position: User-selected off position of any control point must disconnect the load from line supply.
- F. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 by qualified electrical testing laboratory recognized by authorities having jurisdiction and marked for intended location and application.

2.2 WALL-BOX MULTISCENE DIMMING CONTROLS

- A. Description: Factory-fabricated equipment providing manual dimming consisting of a wall-box-mounted master controller[**and indicated number of wall-box zone stations**]. Controls and dimmers must be integrated for mounting in multigang wall box under a single wall plate. Each zone must be adjustable to indicated number of scenes, which must reside in the memory of zone controller.
- B. Dimmers:
 - 1. Each zone must be configurable to control the following loads:
 - a. Fluorescent lamps with **[electronic]** **[magnetic]** ballasts.
 - b. LED lamps.
 - c. Incandescent lamps.
 - d. Control-voltage lamps, derived with **[magnetic]** **[electronic]** transformers.
 - e. Non-dim, on-off switching only.
 - f. **<Insert special lighting equipment>**.
 - 2. Regulate voltages to maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent of RMS voltage.
- C. Memory:
 - 1. Retain preset scenes and fade rates through momentary (up to 3 s) power interruptions.
 - 2. Retain preset scenes through power failures for at least **[seven]** **<Insert number>** days.
- D. Device Cover Plates: Style, material, and color **[must comply with Section 260533.16 "Boxes and Covers for Electrical Systems"]** **<Insert description>**. Master-control cover plate must be one piece.
- E. Master controller must include the following:
 - 1. Cover-mounted switches, including master off, all bright, and selectors for each scene.
 - 2. Cover-mounted LED indicator lights, one associated with each scene switch, and one for the master off switch.
 - 3. Concealed switches and indicators for specified function.
 - 4. A raise/lower switch for each zone for temporary adjustments of the zone, without altering scene values stored in memory.

5. Fade time indicated by digital display for current scene while fading.
6. Cover-mounted infrared receiver.

- F. Infrared Transmitters: Wireless remote control for recalling **[each] [four]** **<Insert number>** of the presets. Operate up to **50 ft.** within line of sight of the master controller.

2.3 MULTIPRESET MODULAR DIMMING CONTROLS

- A. Description: Factory-fabricated equipment providing manual dimming consisting of the following:
1. Master controller.
 2. Dimmer panels[, **and indicated number of zone stations**].
 3. Controls and dimmers must be integrated for mounting in a multigang wall box under a single wall plate.
 4. Each zone must be adjustable to indicated number of scenes, which must reside in the memory of zone controller.
- B. Dimmers:
1. Each zone must be configurable to control the following loads:
 - a. Fluorescent lamps with **[electronic] [magnetic]** ballasts.
 - b. LED lamps.
 - c. Incandescent lamps.
 - d. Control-voltage incandescent lamps, derived with **[magnetic] [electronic]** transformers.
 - e. Non-dim, on-off switching only.
 - f. Neon and cold-cathode lighting.
 - g. **<Insert special lighting equipment>**.
 2. Regulate voltages to maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent of RMS voltage.
- C. Memory: Retain preset scenes and fade settings through power failures by retaining physical settings of controls.
- D. Device Cover Plates: Style, material, and color **[must comply with Section 260533.13 "Boxes and Covers for Electrical Systems"]** **<Insert description>**. Master-control cover plate must be one piece.
- E. Master controller must include the following:
1. Wall-box style, single cover plate supplied by manufacturer.
 2. Cover-mounted switches, including master off, all bright, and selectors for each scene.
 3. Cover-mounted LED indicator lights, one associated with each scene switch, and one for the master off switch.
 4. Concealed switches and indicators for specified function.
 5. A raise/lower switch for each zone for temporary adjustments of the zone, without altering scene values stored in memory.
 6. Fade time indicated by digital display for current scene while fading.
 7. Cover-mounted infrared receiver.
- F. Remote-Control Stations:
1. Numbered push buttons to select scenes.
 2. Off switch to turn master station off.[**Operating the off switch at any remote station**

- must automatically turn on selected housekeeping lighting.]**
 - 3. On switch turns all scenes of master station to full bright.
 - 4. Control Wiring: NFPA 70, Class 2.
 - 5. Mounting: Single flush wall box with manufacturer's [standard faceplate] <Insert special material and color for faceplate>.
 - G. Infrared Remote-Control Station: Same functions as for standard remote-control station except that functions are input by a hand-held infrared transmitter. Operate up to **50 ft.** within line of sight of the master controller.
 - H. Dimmer Panels: Modular, plug-in type, complying with UL 508.
 - 1. Integrated Short-Circuit Rating: **[10 kA at 120 V][, 14 kA at 277 V]**.
 - 2. Dimmers:
 - a. Dimming Circuit: Two SCR dimmers, in inverse parallel configuration.
 - b. Dimming Curve: Modified square law as specified in "The Lighting Handbook" from IES; control voltage is zero to 10 V(dc).
 - c. Dimming Range: Zero to 100 percent, full output voltage not less than 98 percent of line voltage.
 - d. Voltage Regulation: Dimmer must maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent of RMS voltage.
 - I. Circuit Breakers: Complying with UL 489 and classified as switch duty.
- 2.4 CONDUCTORS AND CABLES
- A. Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
 - B. Class 2 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than **[No. 18] [No. 22] [No. 24]** AWG. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING

- A. Wiring Method: Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables" and Section 260533.13 "Conduits for Electrical Systems."
- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors in accordance with conductor manufacturer's instructions.
- C. Size conductors in accordance with lighting control device manufacturer's instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, device, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

- B. Label each dimmer module with a unique designation.
- C. Label each scene control button with approved scene description.

3.3 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by [Architect] [Tenant] [authorities having jurisdiction] <Insert names or titles of witnesses>.
- B. Tests and Inspections:
 - 1. Continuity tests of circuits.
 - 2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of modular dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.
- C. Nonconforming Work:
 - 1. Dimming control components will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- E. Reports: Prepare written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.
- F. Manufacturer Services:
 - 1. Engage factory-authorized service representative to [support] [supervise] field tests and inspections.

END OF SECTION 260936

SECTION 262416.16 - ELECTRONICALLY OPERATED CIRCUIT-BREAKER

PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Panelboards.
 - 2. Circuit breakers.
 - 3. Main controllers.
 - 4. Slave panel controllers.
 - 5. Control network.
 - 6. Manual switches and cover plates.
- B. Related Requirements:
 - 1. Section 260010 "Supplemental Requirements for Electrical" for additional abbreviations, definitions, submittals, qualifications, testing agencies, and other Project requirements applicable to Work specified in this Section.
 - 2. Section 260011 "Facility Performance Requirements for Electrical" for seismic-load, wind-load, acoustical, and other field conditions applicable to Work specified in this Section.

1.2 DEFINITIONS

- A. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for control modules, power distribution components, manual switches and cover plates, and conductors and cables.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For each electronically operated, circuit-breaker panelboard and related equipment.
 - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
 - 6. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
 - 7. Include diagrams for power, signal, and control wiring.
 - 8. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data

communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

9. Submit evidence that electronic controls are compatible with connected monitoring and control devices and systems specified in other Sections.
 - a. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.
 - b. For networked controls, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of network protocol.

C. Field quality-control reports.

D. Sample Warranty: For manufacturer's special warranty.

1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Electrically Operated, Molded-Case Circuit Breakers: Equal to **<Insert number>** percent of amount installed[**for each size indicated**], but no fewer than **<Insert number>**.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Handle and prepare panelboards for installation according to [NECA 407] [NEMA PB 1.1].

1.6 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that components of panelboards perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.
 1. Initial Extended Warranty Period: [**Two**] **<Insert number>** year(s) from date of Substantial Completion, for labor, materials, and equipment.
 2. Follow-on Extended Warranty Period: [**Five**] **<Insert number>** year(s) from date of Substantial Completion, for materials that failed because of transient voltage surges only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Input signal from field-mounted or on-board signal source must open or close one or more electrically operated circuit breakers in electronically operated, circuit-breaker panelboards. Any combination of inputs must be programmable to any combination outputs.
- B. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by a qualified electrical testing laboratory recognized by the authorities having jurisdiction, and marked for intended location and application.
- C. Comply with 47 CFR Part 15, Subpart A and Subpart B, for Class A digital devices.

2.2 PERFORMANCE REQUIREMENTS

- A. Expansion Requirements: Capacity for future expansion of number of control functions by 25 percent of current capacity; to include equipment ratings, housing capacities, spare spaces for circuit breakers, terminals, number of conductors in control cables, and control software.

- B. Interface with DDC System for HVAC: Provide hardware and software to enable DDC system for HVAC to monitor, control, display, and record data for use in processing reports.
 - 1. Hardwired Points:
 - a. Monitoring: On-off status, <Insert monitoring point>.
 - b. Control: On-off operation, <Insert control point>.
 - 2. Communication Interface: Comply with [ASHRAE 135] [ISO/IEC 14908-1] ["MODBUS Application Protocol Specification"] <Insert type of interface> communication interface with DDC system for HVAC must enable DDC system for HVAC operator to remotely control and monitor electronically operated circuit breakers from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at panelboard controller must be available through DDC system for HVAC.

2.3 PANELBOARDS

- A. Electronically operated, circuit-breaker panelboards may contain remotely operated circuit breakers and standard branch circuit breakers specified in Section 262416 "Panelboards."
- B. Assemblies: Comply with UL 67 and NEMA PB 1.
- C. Surge Protective Device:
 - 1. Field mounted, complying with Section 264313 "Surge Protection for Low-Voltage Electrical Power Circuits."
 - 2. Integrally mounted, complying with UL 1449 Type 1.
 - a. Comply with IEEE C62.41, Category C, 200 kA short-circuit current rating.
 - b. Non-modular type with the following features and accessories:
 - 1) Digital-display indicator lights for power and protection status.
 - 2) <Insert features and accessories>.
- D. Enclosures: Comply with UL 50.
- E. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Current Rating:
 - 1. Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by a qualified electrical testing laboratory. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected, short-circuit rating by a qualified electrical testing laboratory.
 - 2. Fully rated to interrupt [**10 kA**] symmetrical short-circuit current available at terminals.

2.4 CIRCUIT BREAKERS

- A. Remotely operated branch circuit breakers must provide branch circuit overcurrent protection.
- B. Labeled with SWD and HID Ratings: Comply with UL 489 for 15 and 20 A, single-pole branch devices. [**15 and 20 A circuit breakers, if scheduled, must be a product of same manufacturer, and be of same class as rated circuit breakers.**]
- C. Switching Endurance Rating: Not less than [**50,000**] [**200,000**] <Insert number> full-load open/close/open remote operations.

- D. Remotely Operated Circuit Breakers: Manual override switch or handle position must enable or disable remote operation of device and allow breaker handle to manually control breaker's on-off status.

2.5 MAIN CONTROLLERS

- A. Description: Controllers must contain power supply and electronic control for operating and monitoring remotely operated branch circuit breakers.
1. Comply with UL 916 (CSA C22.2, No. 205); with a microprocessor-based, solid-state, 365-day timing and control unit.
 2. Power Supply: Powered from panelboard, sized to provide control power for operation of remotely operated circuit breakers, controller, bus system, control-voltage inputs, and field-installed sensors.
 3. Integral keypad and digital-display front panel for local setup, including the following:
 - a. Log and display remotely operated breaker on-time.
 - b. Provision to accept downloadable firmware so that latest features may be added in future without replacing module.
 4. Nonvolatile memory must retain all setup configurations. After a power failure, controller must automatically reboot and return to normal system operation.
 5. Ethernet Communications: Comply with [ASHRAE 135] [ISO/IEC 14908-1] ["**MODBUS Application Protocol Specification**"] <Insert network protocol> protocols.
 - a. Each input connected to controller must control any remotely operated breaker in any other networked electronically operated, circuit-breaker panelboard.
 - b. A schedule programmed at one controller must be able to control any remotely operated breaker in any other networked panelboard.
 6. Time Synchronization: Timing unit must be updated not less than every <Insert **number**> hour(s) with network time server.
 7. Web Server: Display information listed below over a standard Web-enabled server for displaying information over a standard Web browser.
 - a. A secure, password-protected login screen for modifying operational parameters, accessible to authorized users via Web page interface.
 - b. Separate Web page, showing status of each main and slave electronically operated, circuit-breaker panelboards with arrangement of breakers on page matching physical appearance of panel. Status must include breaker nametags, pole configuration, location in panel, actual contact state (on-off/tripped/manual), and breaker on-time.
 - c. Panel summary showing master and slave panels connected to controller.
 - d. Controller diagnostic information.
 - e. Show front panel mimic screens for setting up controller parameters, input types, zones, and operating schedules. These mimic screens must also allow direct breaker control and zone overrides.
 8. Alarm and E-mail Notification: Automatically initiate alarms based on preconfigured conditions listed below and routing alarm alerts as set at control panel.
 - a. General Alarms: Power loss, non-responding breakers, loss and restoration of sub-net communications, loss and restoration of serial port communications, loss and restoration of DDC system for HVAC commands.
 - b. Specific Alarms: Input status, zone status, breaker status on-time (zero to 99999 hours).
 - c. E-mail Notification: Automatically route e-mail messages to five individual e-mail

addresses. Within body text of e-mail, include a link that will automatically redirect user to associated panels' status Web page.

B. Timing Unit:

1. 365-day calendar, astronomical clock, and automatic adjustments for daylight savings and leap year.
2. Clock configurable for 12-hour (A.M./P.M.) or 24-hour format.
3. [16] <Insert number> independent schedules, each having [24] <Insert number> time periods.
4. Schedule periods settable to the minute.
5. Day of week, day of month, day of year with one-time or repeating capability.
6. [32] <Insert number> special date periods.

C. With [eight] [16] <Insert number> inputs, each configurable to the following parameters:

1. Normally open, normally closed, two-wire maintained toggle, two-wire momentary toggle, two-wire momentary on, two-wire momentary off, or three-wire momentary operation.
2. On and off-delay timers for local override operation, adjustable from five minutes to 12 hours. Local override must be by field-installed, two-wire momentary toggle switch.

2.6 SLAVE PANEL CONTROLLERS

- A. Slave panels must contain necessary busses and network hardware to allow connection of sub-net wiring between panels, with programming at main panel controller. Programmable timing unit, Web server, alarm and e-mail notification, and Ethernet connection to control network is not required provided all of these functions are available for slave panel from main panel controller.
- B. Sub-net wiring connections must allow connection of wiring to a terminal that can be removed from panel without interrupting communications to other panels.
- C. Slave panels must contain a nameplate label attached to deadfront trim indicating panel designation, panel network address, and panel designation of associated master panel.

2.7 CONTROL NETWORK

- A. Panel Controllers: Networked with other [electronically operated, circuit-breaker panel controllers] [DDC system for HVAC controllers] in a peer-to-peer configuration using Ethernet [10Base-T] [100Base-T] network.
- B. Protocol: Controllers must support serial MS/TP and Ethernet IP communications, and must be able to communicate directly via DDC system for HVAC TIA-485 serial networks and Ethernet 10Base-T networks as a native device.

2.8 MANUAL SWITCHES AND COVER PLATES

- A. Keypads: Programmable, designed to control functions associated with equipment of this Section. Units must be able to control any system output device.
- B. Push-Button Switches: Modular, momentary-contact, control-voltage type.
1. Match color specified in Section 262726 "Wiring Devices."
 2. Integral green [digital-display] [neon] pilot light to indicate when circuit is on.
 3. Internal white [digital-display] [neon] locator light to illuminate when circuit is off.

- C. Manual, Maintained Contact, Line-Voltage or Control-Voltage Switch: Comply with Section 262726 "Wiring Devices."
- D. Cover Plates: Single and multigang cover plates as specified in Section 260533.16 "Boxes and Covers for Electrical Systems."
- E. Legend: Engraved or permanently silk-screened on cover plate where indicated. Use designations indicated on Drawings.

2.9 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG. Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 and Class 3 Control Cables: Multiconductor cable with copper conductors not smaller than **[No. 18]** **[No. 22]** **[No. 24]** AWG. Comply with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than **[No. 14]** **[No. 16]** **[No. 18]** AWG. Comply with Section 260523 "Control-Voltage Electrical Power Cables."
- D. Twisted-Pair Data Cable:
 - 1. **[Category 5e]** **[Category 6]** **[Category 6a]**. Comply with requirements for twisted pair cabling in Section 260523 "Control-Voltage Electrical Power Cables."
 - 2. **[Category 5e]** **[Category 6]** **[Category 6a]**. Comply with requirements in Section 271513 "Communications Copper Horizontal Cabling."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to **[NECA 407]** **[NEMA PB 1.1]**.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF WIRING

- A. Wiring Method:
 - 1. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.
 - 2. Install cables in raceways and cable trays except within consoles, cabinets, desks, and counters[**and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used**]. Conceal raceway and cables except in unfinished spaces.
 - a. Install plenum cable in environmental air spaces, including plenum ceilings.
 - b. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 - c. Comply with requirements for raceways specified in Section 260533.13 "Conduits

for Electrical Systems."

- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.3 INSTALLATION OF PANELBOARDS

- A. Install panelboards and accessories according to **[NECA 407]** **[NEMA PB 1.1]**.
- B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Mounting Height: **[90 inch]** **<Insert dimension>** to top of trim above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install filler plates in unused spaces.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."
- C. Create a directory to indicate loads served by each circuit; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are unacceptable.
- D. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Field tests and inspections must be witnessed by **[Architect]** **[Tenant]** **[authorities having jurisdiction]** **<Insert names or titles of witnesses>**.
- C. Tests and Inspections:
- D. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate

- compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Nonconforming Work:
1. Panelboard will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.
- G. Manufacturer Services:
1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.
- 3.6 STARTUP SERVICE
- A. **[Engage a factory-authorized service representative to perform]** **[Perform]** startup service.
1. Complete installation and startup checks according to manufacturer's instructions.
 2. Confirm correct communication wiring, initiate communications between panels, and program control system according to approved time-of-day schedules and input override assignments.
 3. **<Insert startup steps if any>**.
- 3.7 ADJUSTING
- A. Occupancy Adjustments: When requested within **[12]** **<Insert number>** months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **[two]** **<Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.
- 3.8 MAINTENANCE
- A. Software and Firmware Service Agreement:
1. Technical Support: Beginning at Substantial Completion, verify that software and firmware service agreement includes software support for **[two]** **<Insert number>** years.
 2. Upgrade Service: At Substantial Completion, update software and firmware to latest version. Install and program software upgrades that become available within **[two]** **<Insert number>** years from date of Substantial Completion. Verify upgrading software includes operating system and new or revised licenses for using software.
 - a. Upgrade Notice: No fewer than **[30]** **<Insert number>** days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.
 3. Upgrade Reports: Prepare written report after each update, documenting upgrades installed.

END OF SECTION 262416.16

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 DEFINITIONS

- A. Commercial/Industrial-Use Cord Reel: A cord reel subject to severe use in factories, commercial garages, construction sites, and similar locations requiring a harder service-type cord.
- B. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.

1.6 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
- B. Preinstallation Coordination Meeting(s): For ceiling-mounted cable reels. Conduct meeting **[as videoconference]** **[or]** **[at Project site]** <Insert location> before <Insert construction activity>.
 - 1. Attendees: Installers, fabricators, representatives of manufacturers, and administrators for field tests and inspections. Notify Architect[, **Construction Manager**] [, and **Owner's Commissioning Authority**] of scheduled meeting dates.

1.7 ACTION SUBMITTALS

- A. Product Data:
 - 1. General-use switches, dimmer switches, and fan-speed controller switches.
 - 2. General-grade single straight-blade receptacles.
 - 3. General-grade duplex straight-blade receptacles.
 - 4. Hospital-grade straight-blade receptacles.
 - 5. Receptacles with arc-fault and ground-fault protective devices.
 - 6. Locking receptacles.
 - 7. Pin-and-sleeve receptacles.
 - 8. Special-purpose power outlet assemblies.
 - 9. Connectors, cords, and plugs.
- B. Shop Drawings:

1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

C. Samples:

1. One for each kind of toggle switch[**and cover plate accessory**] specified, in each finish and color specified.
2. One for each kind of key lock switch[**and cover plate accessory**] specified, in each finish and color specified.
3. One for each kind of maintained-contact switch[**and cover plate accessory**] specified, in each finish and color specified.
4. One for each kind of momentary-contact switch[**and cover plate accessory**] specified, in each finish and color specified.
5. One for each kind of rocker switch[**and cover plate accessory**] specified, in each finish and color specified.
6. One for each kind of dimmer switch[**and cover plate accessory**] specified, in each finish and color specified.
7. One for each kind of fan-speed controller switch[**and cover plate accessory**] specified, in each finish and color specified.
8. One for each kind of single straight-blade receptacle[**and cover plate accessory**] specified, in each finish and color specified.
9. One for each kind of duplex straight-blade receptacle[**and cover plate accessory**] specified, in each finish and color specified.
10. One for each kind of duplex straight-blade receptacle with integral switching means[**and cover plate accessory**] specified, in each finish and color specified.
11. One for each kind of hospital-grade straight-blade receptacle[**and cover plate accessory**] specified, in each finish and color specified.
12. One for each kind of receptacle with AFCI device[**and cover plate accessory**] specified, in each finish and color specified.
13. One for each kind of receptacle with AFCI and GFCI devices[**and cover plate accessory**] specified, in each finish and color specified.
14. One for each kind of receptacle with GFCI device[**and cover plate accessory**] specified, in each finish and color specified.
15. One for each kind of locking receptacle[**and cover plate accessory**] specified, in each finish and color specified.
16. One for each kind of pin-and-sleeve receptacle specified, in each finish and color specified.
17. One for each kind of cord connector specified, in each finish and color specified.

D. Field quality-control reports.

1.8 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions: Record copy of official installation[**and testing**] instructions issued to Installer by manufacturer for the following:
1. Dimmers.
 2. Fan-speed controllers.
 3. Single straight-blade receptacles.
 4. Duplex straight-blade receptacles.
 5. Duplex straight-blade receptacles with integral switching means.
 6. Hospital-grade straight-blade receptacles.
 7. Receptacles with AFCI device.
 8. Receptacles with AFCI and GFCI devices.

9. Receptacles with GFCI device.
10. Locking receptacles.
11. Pin-and-sleeve receptacles.
12. Spring-driven commercial/industrial-use cord reels.
13. Cord reels for use in hazardous locations.

B. Sample warranties.

1.9 CLOSEOUT SUBMITTALS

A. Sustainable Design Closeout Documentation:

1. Record floor plan drawings showing as-installed locations of switches and dimmers, indicating lighting zones each device controls, to verify extent of ability of installed Work to provide occupant control for customizing environment.
2. Record floor plan drawings showing as-installed locations of uncontrolled and marked controlled receptacles superimposed on office furniture layout, to verify extent of ability of installed Work to provide each occupant ability to select at least one uncontrolled receptacle and at least one controlled receptacle for powering workspace equipment. Show locations of UL-approved relocatable power taps and power strips, indicating means of securing for protection from damage and accessibility for inspection. Show locations of temporary extension cords, indicating plan for replacing them with permanent wiring within 90 days.

1.10 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Items: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Extra Keys for Key Lock Switches: **[One]** **<Insert number>** of each kind.
 2. SPD Receptacles: Equal to **[10]** **<Insert number>** percent of quantity installed for each kind specified, but no fewer than **[one]** **<Insert number>** units.
 3. Controlled Receptacles: Equal to **[10]** **<Insert number>** percent of quantity installed for each kind specified, but no fewer than **[one]** **<Insert number>** units.
 4. Cord Connectors: **[One]** **<Insert number>** of each kind.
- B. Special Tools:
1. Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to controlled receptacles.
 2. Proprietary equipment required to maintain, repair, adjust, or implement future changes to cord connectors.

1.11 WARRANTY FOR DEVICES

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.
1. Initial Extended Warranty Period: **[Three]** **[Four]** **[Five]** **<Insert number>** years from date of Substantial Completion; **[full]** **[prorated]** coverage for labor, materials, and equipment.
 2. Follow-On Extended Warranty Period: **[Eight]** **<Insert number>** years from date of Substantial Completion; **[full]** **[prorated]** coverage for materials **[that failed because of transient voltage surges]** only, free on board **[origin]** **[destination]**, freight prepaid.

1.12 WARRANTY FOR CORD REELS

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed cord-reel power outlet assemblies perform in accordance with specified requirements and agrees to repair or replace assemblies that fail to perform as specified within extended warranty period.
 - 1. Extended Warranty Period: [**Two**] [**Three**] [**Four**] **<Insert number>** years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that components of cord-reel power outlet assemblies perform in accordance with specified requirements and agrees to provide repair or replacement of components that fail to perform as specified within extended warranty period.
 - 1. Initial Extended Warranty Period: [**Three**] [**Four**] [**Five**] **<Insert number>** years from date of Substantial Completion; [**full**] [**prorated**] coverage for labor, materials, and equipment.
 - 2. Follow-On Extended Warranty Period: [**Eight**] **<Insert number>** years from date of Substantial Completion; [**full**] [**prorated**] coverage for materials[**that failed because of transient voltage surges**] only, free on board [**origin**] [**destination**], freight prepaid.

PART 2 - PRODUCTS

2.1 OWNER-FURNISHED PRODUCTS

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for product that Owner intends to furnish to Contractor>**.
- B. Description: **<Insert description of product, including special features, options, and finishes for Owner-furnished product that may impact Contractor's installation>**.
- C. Accessories: **<Insert accessories that will be provided with product>**.

2.2 EXISTING PRODUCTS TO BE MODIFIED

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.
- C. Accessories: **<Insert accessories included with existing product>**.

2.3 EXISTING PRODUCTS TO BE REMOVED AND RE-INSTALLED

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.
- C. Accessories: **<Insert accessories included with existing product>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receptacles:

1. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.
- B. Cord Reels:
 1. Examine roughing-in for cord reel mounting and power connections to verify actual locations of mounts and power connections before cord reel installation.
 2. Examine walls, floors, and ceilings for suitable conditions where cord reel will be installed.
 3. Proceed with installation only after unsatisfactory conditions have been corrected.
- 3.2 SELECTION OF CONTROLLED AND UNCONTROLLED RECEPTACLES
 - A. Private and Open Office Spaces:
 1. Uncontrolled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one uncontrolled receptacle is selected for installation not greater than **6 ft** from each workstation.
 2. Controlled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one controlled receptacle is selected for installation not greater than **6 ft** from each workstation.
 3. Contact Architect for resolution of discrepancies between these requirements and Drawings.
- 3.3 SELECTION OF GFCI RECEPTACLES
 - A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.
- 3.4 INSTALLATION OF SWITCHES
 - A. Comply with manufacturer's instructions.
 - B. Reference Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 3. Consult Architect for resolution of conflicting requirements.
 - C. Identification:
 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with **[black]** **[white]** **[red]**-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.
 - D. Interfaces with Other Work:
 1. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.

2. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>**.
 - a. **<Insert requirements for transition between this Section and related Work>**.
- 3.5 INSTALLATION OF STRAIGHT-BLADE RECEPTACLES
- A. Comply with manufacturer's instructions.
 - B. Reference Standards:
 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 - a. Hospital-Grade Receptacle Orientation: Orient receptacle with ground pin or neutral pin at top.
 4. Consult Architect for resolution of conflicting requirements.
 - C. Identification:
 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with **[black] [white] [red]**-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.
 - D. Interfaces with Other Work:
 1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.
 2. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.
 3. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>**.
 - a. **<Insert requirements for transition between this Section and related Work>**.
- 3.6 INSTALLATION OF CORD REELS AND FITTINGS
- A. Comply with manufacturer's instructions.
 - B. Special Techniques:
 1. **<Insert more stringent installation requirements that supplement or supersede manufacturers' instructions>**.
 - C. Interfaces with Other Work:
 1. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.
 2. Coordinate with **<Insert Section number and title>** for **<Insert description of**

interfacing related Work>.

a. **<Insert requirements for transition between this Section and related Work>.**

3.7 FIELD QUALITY CONTROL OF SWITCHES

- A. Acceptance Testing Preparation:
 - 1. **<Insert requirements>.**
- B. Field tests and inspections must be witnessed by **[Architect] [Tenant] [authorities having jurisdiction] <Insert names or titles of witnesses>.**
- C. Tests and Inspections:
 - 1. Perform tests and inspections in accordance with manufacturers' instructions.
 - 2. **<Insert tests and inspections>.**
- D. Nonconforming Work:
 - 1. Unit will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- E. Assemble and submit test and inspection reports.
- F. Manufacturer Services:
 - 1. Engage factory-authorized service representative to **[support] [supervise]** field tests and inspections.

3.8 FIELD QUALITY CONTROL OF STRAIGHT-BLADE RECEPTACLES

- A. Acceptance Testing Preparation:
 - 1. **<Insert requirements>.**
- B. Field tests and inspections must be witnessed by **[Architect] [Tenant] [authorities having jurisdiction] <Insert names or titles of witnesses>.**
- C. Tests and Inspections:
 - 1. Insert and remove test plug to verify that device is securely mounted.
 - 2. Verify polarity of hot and neutral pins.
 - 3. Measure line voltage.
 - 4. Measure percent voltage drop.
 - 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
 - 6. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 115 g (4 oz).
 - 7. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
 - 8. **<Insert tests and inspections>.**
- D. Nonconforming Work:
 - 1. Device will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- E. Assemble and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.

3.9 FIELD QUALITY CONTROL OF CORD REELS AND FITTINGS

A. Acceptance Testing Preparation:

1. **<Insert requirements>**.

B. Field tests and inspections must be witnessed by **[Architect]** **[Tenant]** **[authorities having jurisdiction]** **<Insert names or titles of witnesses>**.

C. Tests and Inspections:

1. Perform tests and inspections indicated in manufacturer's instructions.
2. **<Insert Project-specific test or inspection>**.

D. Nonconforming Work:

1. Components and assemblies will be considered defective if they do not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Assemble and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.

3.10 SYSTEM STARTUP FOR SWITCHES

A. **[Engage a factory-authorized service representative to perform]** **[Perform]** startup service.

1. Complete installation and startup checks for momentary switches, dimmer switches, and fan-speed controller switches in accordance with manufacturer's instructions.

3.11 ADJUSTING

A. Occupancy Adjustments for Controlled Receptacles: When requested within **[12]** **<Insert number>** months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to **[two]** **<Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.

B. Cord Reels and Fittings: Adjust spring mechanisms and moving parts of cord reels and fittings to function smoothly, and lubricate as recommended in writing by manufacturer.

3.12 PROTECTION

A. Devices:

1. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
2. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

B. Cord Reels and Fittings:

1. After installation, protect cord reels and fittings from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

C. Connectors, Cords, and Plugs:

1. After installation, protect connectors, cords, and plugs from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726

SECTION 262726.11 - GENERAL-USE SWITCHES, DIMMER SWITCHES, AND FAN-SPEED CONTROLLER SWITCHES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 DEFINITIONS

- A. UL 1472 Type I Dimmer: Dimmer in which air-gap switch is used to energize preset lighting levels.
- B. UL 1472 Type II Dimmer: Dimmer with air-gap switch that opens and closes load circuit at minimum output voltage setting only.
- C. UL 1472 Type IIa Dimmer: Dimmer with air-gap switch that opens and closes load circuit at maximum output voltage setting only.
- D. UL 1472 Type III Dimmer: Dimmer incorporating solid-state components providing preestablished rectified output settings.
- E. UL 1472 Type IV Dimmer: Dimmer not covered by UL 1472 Types I through III.

1.6 ACTION SUBMITTALS

- A. Product Data:

- 1. General-use switches.
- 2. General-use dimmer switches.
- 3. General-use fan-speed controller switches.

- B. Samples:

- 1. One for each kind of toggle switch[**and cover plate accessory**] specified, in each finish and color specified.
- 2. One for each kind of key lock switch[**and cover plate accessory**] specified, in each finish and color specified.
- 3. One for each kind of maintained-contact switch[**and cover plate accessory**] specified, in each finish and color specified.
- 4. One for each kind of momentary-contact switch[**and cover plate accessory**] specified, in each finish and color specified.

5. One for each kind of rocker switch[**and cover plate accessory**] specified, in each finish and color specified.
6. One for each kind of dimmer switch[**and cover plate accessory**] specified, in each finish and color specified.
7. One for each kind of fan-speed controller switch[**and cover plate accessory**] specified, in each finish and color specified.

C. Field quality-control reports.

1.7 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions: Record copy of official installation[**and testing**] instructions issued to Installer by manufacturer for the following:
1. Dimmers.
 2. Fan-speed controllers.

1.8 CLOSEOUT SUBMITTALS

- A. Sustainable Design Closeout Documentation:
1. Record floor plan drawings showing as-installed locations of switches and dimmers, indicating lighting zones each device controls, to verify extent of ability of installed Work to provide occupant control for customizing environment.

1.9 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Items: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Extra Keys for Key Lock Switches: [**One**] **<Insert number>** of each kind.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS TO BE MODIFIED

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.
- C. Accessories: **<Insert accessories included with existing product>**.

2.2 EXISTING PRODUCTS TO BE REMOVED AND RE-INSTALLED

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.
- C. Accessories: **<Insert accessories included with existing product>**.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:

1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
3. Consult Architect for resolution of conflicting requirements.

C. Identification:

1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with **[black] [white] [red]**-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

D. Interfaces with Other Work:

1. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.
2. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>**.
 - a. **<Insert requirements for transition between this Section and related Work>**.

3.2 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. **<Insert requirements>**.

B. Field tests and inspections must be witnessed by **[Architect] [Tenant] [authorities having jurisdiction] <Insert names or titles of witnesses>**.

C. Tests and Inspections:

1. Perform tests and inspections in accordance with manufacturers' instructions.
2. **<Insert tests and inspections>**.

D. Nonconforming Work:

1. Unit will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Assemble and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to **[support] [supervise]** field tests and inspections.

3.3 SYSTEM STARTUP

A. **[Engage a factory-authorized service representative to perform] [Perform]** startup service.

1. Complete installation and startup checks for momentary switches, dimmer switches, and fan-speed controller switches in accordance with manufacturer's instructions.

3.4 PROTECTION

- A. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
- B. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.11

**SECTION 262726.33 - GENERAL-GRADE DUPLEX STRAIGHT-BLADE
RECEPTACLES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 ACTION SUBMITTALS

- A. Product Data:

1. Duplex straight-blade receptacles.
2. Duplex straight-blade receptacles with integral switching means.

- B. Shop Drawings:

1. Wiring diagrams for duplex straight-blade receptacles with integral switching means.

- C. Samples:

1. One for each kind of duplex straight-blade receptacle[**and cover plate accessory**] specified, in each finish and color specified.
2. One for each kind of duplex straight-blade receptacle with integral switching means[**and cover plate accessory**] specified, in each finish and color specified.

- D. Field quality-control reports.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions: Record copy of official installation[**and testing**] instructions issued to Installer by manufacturer for the following:

1. Duplex straight-blade receptacles.
2. Duplex straight-blade receptacles with integral switching means.

- B. Sample warranties.

1.7 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

- B. Sustainable Design Closeout Documentation:

1. Record floor plan drawings showing as-installed locations of uncontrolled and marked controlled receptacles superimposed on office furniture layout, to verify extent of ability

of installed Work to provide each occupant ability to select at least one uncontrolled receptacle and at least one controlled receptacle for powering workspace equipment. Show locations of UL-approved relocatable power taps and power strips, indicating means of securing for protection from damage and accessibility for inspection. Show locations of temporary extension cords, indicating plan for replacing them with permanent wiring within 90 days.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Items: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. SPD Receptacles: Equal to [10] <Insert number> percent of quantity installed for each kind specified, but no fewer than [one] <Insert number> units.
 - 2. Controlled Receptacles: Equal to [10] <Insert number> percent of quantity installed for each kind specified, but no fewer than [one] <Insert number> units.
- B. Special Tools: Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to controlled receptacles.

1.9 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.
 - 1. Initial Extended Warranty Period: [Three] [Four] [Five] <Insert number> years from date of Substantial Completion; [full] [prorated] coverage for labor, materials, and equipment.
 - 2. Follow-On Extended Warranty Period: [Eight] <Insert number> years from date of Substantial Completion; [full] [prorated] coverage for materials[that failed because of transient voltage surges] only, free on board [origin] [destination], freight prepaid.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS TO BE MODIFIED

- A. Basis for Pricing: <Insert name of manufacturer; model number or series for existing product>.
- B. Description: <Insert description of existing product, including special features, options, and finishes that may impact Work>.
- C. Accessories: <Insert accessories included with existing product>.

2.2 EXISTING PRODUCTS TO BE REMOVED AND RE-INSTALLED

- A. Basis for Pricing: <Insert name of manufacturer; model number or series for existing product>.
- B. Description: <Insert description of existing product, including special features, options, and finishes that may impact Work>.
- C. Accessories: <Insert accessories included with existing product>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 SELECTION OF CONTROLLED AND UNCONTROLLED RECEPTACLES

- A. Private and Open Office Spaces:
 - 1. Uncontrolled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one uncontrolled receptacle is selected for installation not greater than **6 ft** from each workstation.
 - 2. Controlled Receptacles at Workstations: Coordinate final locations of receptacles with furniture plan such that at least one controlled receptacle is selected for installation not greater than **6 ft** from each workstation.
 - 3. Contact Architect for resolution of discrepancies between these requirements and Drawings.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 - 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 - 4. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 - 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with **[black] [white] [red]**-filled lettering, and provide durable wire markers or tags inside device box or outlet box.
 - b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.
- D. Interfaces with Other Work:
 - 1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.
 - 2. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.
 - 3. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>**.
 - a. **<Insert requirements for transition between this Section and related Work>**.

3.4 FIELD QUALITY CONTROL

- A. Acceptance Testing Preparation:
 - 1. **<Insert requirements>**.
- B. Field tests and inspections must be witnessed by [Architect] [Tenant] [authorities having jurisdiction] **<Insert names or titles of witnesses>**.
- C. Tests and Inspections:
 - 1. Insert and remove test plug to verify that device is securely mounted.
 - 2. Verify polarity of hot and neutral pins.
 - 3. Measure line voltage.
 - 4. Measure percent voltage drop.
 - 5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
 - 6. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 115 g (4 oz).
 - 7. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
 - 8. **<Insert tests and inspections>**.
- D. Nonconforming Work:
 - 1. Device will be considered defective if it does not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- E. Assemble and submit test and inspection reports.
- F. Manufacturer Services:
 - 1. Engage factory-authorized service representative to [support] [supervise] field tests and inspections.

3.5 ADJUSTING

- A. Occupancy Adjustments for Controlled Receptacles: When requested within [12] **<Insert number>** months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to [two] **<Insert number>** visits to Project during other-than-normal occupancy hours for this purpose.

3.6 PROTECTION

- A. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.
- B. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.33

**SECTION 262726.37 - RECEPTACLES WITH ARC-FAULT AND GROUND-FAULT
PROTECTIVE DEVICES**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 ACTION SUBMITTALS

- A. Product Data:

1. Receptacles with AFCI devices.
2. Receptacles with both AFCI and GFCI devices.
3. Receptacles with GFCI devices.

- B. Samples:

1. One for each kind of receptacles with AFCI devices[**and cover plate accessory**] specified, in each finish and color specified.
2. One for each kind of receptacles with AFCI and GFCI devices[**and cover plate accessory**] specified, in each finish and color specified.
3. One for each kind of receptacles with GFCI devices[**and cover plate accessory**] specified, in each finish and color specified.

- C. Field quality-control reports.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturers' Instructions: Record copy of official installation[**and testing**] instructions issued to Installer by manufacturer for the following:

1. Receptacles with AFCI devices.
2. Receptacles with both AFCI and GFCI devices.
3. Receptacles with GFCI devices.

- B. Sample warranties.

1.7 WARRANTY

- A. Special Manufacturer Extended Warranty: Manufacturer warrants that devices perform in accordance with specified requirements and agrees to provide repair or replacement of devices that fail to perform as specified within extended warranty period.

1. Extended Warranty Period: [**Three**] [**Four**] [**Five**] **<Insert number>** years from date of

Substantial Completion; **[full]** **[prorated]** coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS TO BE MODIFIED

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.
- C. Accessories: **<Insert accessories included with existing product>**.

2.2 EXISTING PRODUCTS TO BE REMOVED AND RE-INSTALLED

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.
- C. Accessories: **<Insert accessories included with existing product>**.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that receptacles to be procured and installed for Owner-furnished equipment are compatible with mating attachment plugs on equipment.

3.2 SELECTION OF GFCI RECEPTACLES

- A. Healthcare Facilities: Unless protection of downstream branch-circuit wiring, cord sets, and power-supply cords is required by NFPA 70 or NFPA 99, provide non-feed-through GFCI receptacles.

3.3 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
 - 1. Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with installation instructions in NECA NEIS 130.
 - 2. Mounting Heights: Unless otherwise indicated in Contract Documents, comply with mounting heights recommended in NECA NEIS 1.
 - 3. Receptacle Orientation: Unless otherwise indicated in Contract Documents, orient receptacle to match configuration diagram in NEMA WD 6.
 - a. Hospital-Grade Receptacle Orientation: Orient receptacle with ground pin or neutral pin at top.
 - 4. Consult Architect for resolution of conflicting requirements.
- C. Identification:
 - 1. Identify cover or cover plate for device with panelboard identification and circuit number in accordance with Section 260553 "Identification for Electrical Systems."
 - a. Mark cover or cover plate using hot, stamped, or engraved machine printing with **[black]** **[white]** **[red]**-filled lettering, and provide durable wire markers or tags

- inside device box or outlet box.
- b. Healthcare Facilities: Distinctively identify covers or cover plates of device boxes and outlet boxes that are supplied from life safety and critical branch power supplies following facility's standard practice.

D. Interfaces with Other Work:

1. Do not install Type 3 SPD, including surge-protected relocatable taps and power strips, on branch circuit downstream of GFCI device.
2. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.
3. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>**.
 - a. **<Insert requirements for transition between this Section and related Work>**.

3.4 FIELD QUALITY CONTROL

A. Acceptance Testing Preparation:

1. **<Insert requirements>**.

B. Field tests and inspections must be witnessed by **[Architect]** **[Tenant]** **[authorities having jurisdiction]** **<Insert names or titles of witnesses>**.

C. Tests and Inspections:

1. Insert and remove test plug to verify that device is securely mounted.
2. Verify polarity of hot and neutral pins.
3. Measure line voltage.
4. Measure percent voltage drop.
5. Measure grounding circuit continuity; impedance must be not greater than 2 ohms.
6. Healthcare Facilities: Test straight-blade receptacles in patient care spaces with receptacle pin tension test instrument in accordance with NFPA 99. Retention force of ground pin must be not less than 115 g (4 oz).
7. Perform additional installation and maintenance inspections and diagnostic tests in accordance with NECA NEIS 130 and manufacturers' instructions.
8. **<Insert tests and inspections>**.

D. Nonconforming Work:

1. Device will be considered defective if it does not pass tests and inspections.
2. Remove and replace defective units and retest.

E. Assemble and submit test and inspection reports.

F. Manufacturer Services:

1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.

3.5 PROTECTION

- A. Schedule and sequence installation to minimize risk of contamination of wires and cables, devices, device boxes, outlet boxes, covers, and cover plates by plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other materials.

- B. After installation, protect wires and cables, devices, device boxes, outlet boxes, covers, and cover plates from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.37

SECTION 262726.51 - CONNECTORS, CORDS, AND PLUGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:

1.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

1.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

1.4 ALTERNATES

- A. See Section 012300 "Alternates" for description of alternates affecting items specified in this Section.

1.5 ACTION SUBMITTALS

- A. Product Data:

1. Fuseless attachment cord connectors.
2. Extra-hard-usage, jacketed, flexible cord.
3. Antimicrobial, extra-hard-usage, jacketed, flexible cord.
4. Hard-usage, jacketed, flexible cord.
5. Strain-relief cord grips.

- B. Samples:

1. One for each kind of cord connector specified, in each finish and color specified.

- C. Field Quality-Control Submittals:

1. Field quality-control reports.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Items: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cord Connectors: [**One**] **<Insert number>** of each kind.

- B. Special Tools: Proprietary equipment and software required to maintain, repair, adjust, or implement future changes to cord connectors.

PART 2 - PRODUCTS

2.1 EXISTING PRODUCTS[**TO BE MODIFIED**] [**TO BE REMOVED AND RE-INSTALLED**]

- A. Basis for Pricing: **<Insert name of manufacturer; model number or series for existing product>**.
- B. Description: **<Insert description of existing product, including special features, options, and finishes that may impact Work>**.

- C. Accessories: **<Insert accessories included with existing product>**.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions.
- B. Reference Standards:
1. **<Insert system or product group>**: Unless more stringent requirements are specified in Contract Documents or manufacturers' instructions, comply with **<Insert list of standards designations>**.
 2. Consult Architect for resolution of conflicting requirements.
- C. Special Techniques:
1. **<Insert more stringent installation requirements that supplement or supersede listed standards and manufacturers' instructions>**.
- D. Interfaces with Other Work:
1. Coordinate with Section 262726.43 "Special-Purpose Power Outlet Assemblies" for installation of connectors and cords on fabricated power-outlet cord management assemblies.
 2. Coordinate installation of new products for **<Insert system or product group>** with existing conditions.
 - a. **<Insert requirements for transition between new and existing>**.
 3. Coordinate with **<Insert Section number and title>** for **<Insert description of interfacing related Work>**.
 - a. **<Insert requirements for transition between this Section and related Work>**.

3.2 FIELD QUALITY CONTROL

- A. **[Acceptance]** Testing Preparation:
1. **<Insert requirements>**.
- B. Field tests and inspections must be witnessed by **[Architect]** **[Tenant]** **[authorities having jurisdiction]** **<Insert names or titles of witnesses>**.
- C. Tests and Inspections:
1. Perform tests and inspections indicated in manufacturer's instructions.
 2. **<Insert Project-specific test or inspection>**.
- D. Nonconforming Work:
1. Unit will be considered defective if it does not pass tests and inspections.
 2. Remove and replace defective units and retest.
- E. Assemble and submit test and inspection reports.
- F. Manufacturer Services:
1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.

3.3 PROTECTION

- A. After installation, protect connectors, cords, and plugs from construction activities. Remove

and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 262726.51

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Molded-case circuit breakers (MCCBs).
 - 2. Enclosures.

1.2 DEFINITIONS

- A. GFEP: Ground-fault circuit-interrupter for equipment protection.
- B. GFLS: Ground-fault circuit-interrupter for life safety.
- C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 2. Enclosure types and details for types other than UL 50E, Type 1.
 - 3. Current and voltage ratings.
 - 4. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 5. Include evidence of qualified electrical testing laboratory listing for series rating of installed devices.
 - 6. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
 - 7. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in **[PDF]** **[and]** **<Insert calculation program format>** electronic format.
- B. Shop Drawings: For enclosed switches and circuit breakers.
 - 1. Include plans, elevations, sections, details, and attachments to other work.
 - 2. Include wiring diagrams for power, signal, and control wiring.
- C. Field Quality-Control Submittals:
 - 1. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Spare Parts: Furnish to Owner spare parts, for repairing enclosed switches and circuit breakers, that are packaged with protective covering for storage on-site and identified with labels

describing contents. [**Include the following:**]

1. Fuses: Equal to [10] <Insert number> percent of quantity installed for each size and type, but no fewer than [three] <Insert number> of each size and type.
2. Fuse Pullers: [Two] <Insert number> for each size and type.
3. <Insert spare parts>.

1.7 WARRANTY

- A. Special Installer Extended Warranty: Installer warrants that fabricated and installed enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period.
 1. Extended-Warranty Period: [Two] <Insert number> years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that enclosed switches and circuit breakers perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period.
 1. Extended-Warranty Period: [Three] <Insert number> years from date of Substantial Completion; [full] [prorated] coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain products from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.

2.2 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, UL 50E, and UL 50, to comply with environmental conditions at installed location.
- B. Enclosure Finish: Enclosure must be [finished with] [gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (UL 50E Type 1)] [gray baked enamel paint, electrodeposited on cleaned, phosphatized galvanized steel (UL 50E Types 3R, 12)] [a brush finish on Type 304 stainless steel (UL 50E Type 4-4X stainless steel)] [copper-free cast aluminum alloy (UL 50E Types 7, 9)].
- C. Conduit Entry: UL 50E Types 4, 4X, and 12 enclosures may not contain knockouts. UL 50E Types 7 and 9 enclosures must be provided with threaded conduit openings in both endwalls.
- D. Operating Mechanism: Circuit-breaker operating handle must be [externally operable with operating mechanism being integral part of box, not cover] [directly operable through front cover of enclosure (UL 50E Type 1)] [directly operable through dead front trim of enclosure (UL 50E Type 3R)] [externally operable with operating mechanism being

integral part of cover (UL 50E Types 7, 9)]. Cover interlock mechanism must have externally operated override. Override may not permanently disable interlock mechanism, which must return to locked position once override is released. Tool used to override cover interlock mechanism must not be required to enter enclosure in order to override interlock.

- E. Enclosures designated as UL 50E Type 4, 4X stainless steel, 12, or 12K must have dual cover interlock mechanism to prevent unintentional opening of enclosure cover when circuit breaker is ON and to prevent turning circuit breaker ON when enclosure cover is open.
- F. UL 50E Type 7/9 enclosures must be furnished with breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work will indicate Installer's acceptance of areas and conditions as satisfactory.

3.2 SELECTION OF ENCLOSURES

- A. Indoor, Dry and Clean Locations: UL 50E, [**Type 1**] **<Insert type>**.
- B. Outdoor Locations: UL 50E, [**Type 3R**] [**Type 4X**] **<Insert type>**.
- C. [**Kitchen**] [**Wash-Down**] Areas: UL 50E, [**Type 4X**] **<Insert type>**, [**stainless steel**] **<Insert material>**.
- D. Other Wet or Damp, Indoor Locations: UL 50E, [**Type 4**] **<Insert type>**.
- E. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: UL 50E, Type 12.
- F. Hazardous Areas Indicated on Drawings: UL 50E, [**Type 7**] [**Type 9**] **<Insert type>** [**with cover attached by Type 316 stainless steel bolts**].

3.3 INSTALLATION

- A. Comply with manufacturer's published instructions.
- B. Special Techniques:
 - 1. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
 - 2. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
 - 3. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
 - 4. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets

and temporary blocking of moving parts from enclosures and components.

5. Install fuses in fusible devices.

3.4 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.5 FIELD QUALITY CONTROL

- A. **[Acceptance]** Testing Preparation:
 1. **<Insert requirements>**.
- B. Field tests and inspections must be witnessed by **[Architect]** **[Tenant]** **[authorities having jurisdiction]** **<Insert names or titles of witnesses>**.
- C. Tests and Inspections for Switches:
 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

- c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test in accordance with NETA ATS Section 7.14 "Ground Fault Protection Systems, Low-Voltage."
- D. Tests and Inspections for Molded-Case Circuit Breakers:
- 1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that unit is clean.
 - e. Operate circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the following methods:
 - 1) Use low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels must be in accordance with manufacturer's published data. In absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with coordination study.
 - 2. Electrical Tests:
 - a. Perform resistance measurements through bolted connections with low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In absence of manufacturer's published data, use Table 100.1 from NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform contact/pole resistance test. Drop values may not exceed high level of manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of lowest value.

- d. Perform insulation resistance tests on control wiring with respect to ground. Applied potential must be 500 V(dc) for 300 V rated cable and 1000 V(dc) for 600 V rated cable. Test duration must be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values may be no less than 2 MΩ.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values must be as specified. Trip characteristics may not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 4) Instantaneous pickup. Instantaneous pickup values must be as specified and within manufacturer's published tolerances.
 - f. Test functionality of trip unit by means of primary current injection. Pickup values and trip characteristics must be as specified and within manufacturer's published tolerances.
 - g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of shunt trip and close coils must be as indicated by manufacturer.
 - h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset trip logs and indicators. Investigate units that do not function as designed.
 - i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Test and adjust controls, remote monitoring, and safeties.
- E. Nonconforming Work:
- 1. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- F. Collect, assemble, and submit test and inspection reports.
- 1. Test procedures used.
 - 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 - 3. List deficiencies detected, remedial action taken, and observations after remedial action.
- G. Manufacturer Services:
- 1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.
- 3.6 ADJUSTING
- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges[**as specified in Section 260573.16 "Coordination Studies."**] [**to values indicated on Drawings.**] [**to values indicated in attached schedule.**]

3.7 PROTECTION

- A. After installation, protect enclosed switches and circuit breakers from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

3.8 MAINTENANCE

- A. Infrared Scanning of Enclosed Switches and Breakers: Two months after Substantial Completion, perform infrared scan of joints and connections. Remove covers so joints and connections are accessible to portable scanner. Take visible light photographs at same locations and orientations as infrared scans for documentation to ensure follow-on scans match same conditions for valid comparison.
 - 1. Instruments and Equipment: Use infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 2. Follow-up Infrared Scanning: Perform two follow-up infrared scans of enclosed switches and breakers, one at four months and another at 11 months after Substantial Completion.
 - 3. Instrument: Use infrared-scanning device designed to measure temperature or to detect significant deviations from normal values. Provide documentation of device calibration.
 - 4. Report: Prepare certified report that identifies units checked and that describes scanning results. Include notation of deficiencies detected, remedial actions taken, and scanning observations after remedial action.

END OF SECTION 262816

**SECTION 264313 - SURGE PROTECTIVE DEVICES FOR LOW-VOLTAGE
ELECTRICAL POWER CIRCUITS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Type 3, Type 4, and Type 5 surge protective devices (SPDs).
 - 2. Enclosures.
 - 3. Conductors and cables.

1.2 DEFINITIONS

- A. In: Nominal discharge current.
- B. Maximum Continuous Operating Voltage (MCOV): The maximum designated RMS value of the power frequency voltage that may be continuously applied to the mode of protection of an SPD.
- C. Metal-Oxide Varistor (MOV): An electronic component with a significant bidirectional, nonlinear current-voltage characteristic.
- D. Mode(s), Modes of Protection, or Protection Modes: Electrical paths where the SPD offers defense against transient overvoltages. Examples include: line to neutral (L-N), line to ground (L-G), line to line (L-L), and neutral to ground (N-G).
- E. SCCR: Short-circuit current rating.
- F. Type 1 SPDs: Permanently connected SPDs intended for installation between the secondary of the service transformer and the line side of the service disconnect overcurrent device.
- G. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
- H. Type 3 SPDs: Point of utilization SPDs.
- I. Type 4 SPDs: Component SPDs, including discrete components, as well as assemblies.
- J. Type 5 SPDs: Discrete component surge suppressors, such as MOVs that may be mounted on a printed wiring board, connected by its leads or provided within an enclosure with mounting means and wiring terminations.
- K. Voltage Protection Rating (VPR): A rating selected from UL 1449 list of preferred values assigned to each mode of protection.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of product.
 - a. Include electrical characteristics, specialties, and accessories for SPDs.
 - b. Certification of compliance with UL 1449 by qualified electrical testing laboratory recognized by authorities having jurisdiction including the following information:

- 1) Tested values for VPRs.
- 2) In ratings.
- 3) MCOV, type designations.
- 4) OCPD requirements.
- 5) Manufacturer's model number.
- 6) System voltage.
- 7) Modes of protection.

B. Field quality-control reports.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For manufacturer's special warranty.

1.5 WARRANTY

A. Special Manufacturer Extended Warranty: Manufacturer warrants that SPDs perform in accordance with specified requirements and agrees to provide repair or replacement of SPDs that fail to perform as specified within extended warranty period.

1. Initial Extended Warranty Period: [**Five**] <Insert number> year(s) from date of Substantial Completion, for labor, materials, and equipment.
2. Follow-On Extended Warranty Period: [**10**] <Insert number> year(s) from date of Substantial Completion, for materials only, f.o.b. the nearest shipping point to Project site.

PART 2 - PRODUCTS

2.1 TYPE 3, TYPE 4, AND TYPE 5 SURGE PROTECTIVE DEVICES (SPDs)

A. Type 3, Type 4, and Type 5 SPDs are not approved for field installation.[See "**Related Requirements**" Paragraph in "**Summary**" Article for products with manufacturer-installed Type 3, Type 4, and Type 5 SPDs.]

2.2 ENCLOSURES

- A. Indoor Enclosures: Type 1.
- B. Outdoor Enclosures: [**Type 3R**] [**Type 4X**].

2.3 CONDUCTORS AND CABLES

A. Power Wiring: Same size as SPD leads, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer's instructions.
- B. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer's instructions. Comply with wiring methods in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
 2. Do not exceed manufacturer's recommended lead length.
 3. Do not bond neutral and ground.

- C. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by **[Architect]** **[Tenant]** **[authorities having jurisdiction]** **<Insert names or titles of witnesses>**.
- B. Tests and Inspections:
 - 1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
 - 2. Inspect anchorage, alignment, grounding, and clearances.
 - 3. Verify that electrical wiring installation complies with manufacturer's installation requirements.
- C. Nonconforming Work:
 - 1. SPDs that do not pass tests and inspections will be considered defective.
 - 2. Remove and replace defective units and retest.
- D. Prepare test and inspection reports.
- E. Manufacturer Services:
 - 1. Engage factory-authorized service representative to **[support]** **[supervise]** field tests and inspections.

3.3 STARTUP SERVICE

- A. Complete startup checks in accordance with manufacturer's instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

END OF SECTION 264313

SECTION 265119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Materials.
 - 2. Luminaire support.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests[, **complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project**] [IES LM-79] [and] [IES LM-80].
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

- C. Sustainable Design Submittals:
 - 1. Product Data: Indicating luminaire is certified by **[ENERGY STAR] [Design Lights Consortium]**.
 - D. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
 - E. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
 - 1. Include Samples of luminaires and accessories involving color and finish selection.
 - F. Samples for Verification: For each type of luminaire.
 - 1. Include Samples of luminaires and accessories to verify finish selection.
 - G. Product Schedule: For luminaires and lamps. **[Use same designations indicated on Drawings.]**
- 1.4 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.
 - 3. Partitions and millwork that penetrate the ceiling or extend to within **12 inches** of the plane of the luminaires.
 - 4. Structural members to which **[equipment] [and] [or]** luminaires will be attached.
 - 5. Initial access modules for acoustical tile, including size and locations.
 - 6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
 - g. **<Insert item>**.
 - 7. Moldings.
 - 8. **<Insert feature>**.
 - B. Qualification Data: For testing laboratory providing photometric data for luminaires.
 - C. Seismic Qualification Data: For luminaires, accessories, and 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 the certification is based and their installation requirements.
 - D. Product Certificates: For each type of luminaire.
 - E. Product Test Reports: For each type of luminaire, for tests performed by **[manufacturer and**

witnessed by a qualified testing agency] [a qualified testing agency].

- F. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

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. Lamps: [**Ten for every 100**] <Insert quantity> of each type and rating installed. Furnish at least one of each type.
2. Diffusers and Lenses: [**One for every 100**] <Insert quantity> of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: [**One for every 20**] <Insert quantity> of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:

1. Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

- B. Provide luminaires from a single manufacturer for each luminaire type.

- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

- D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that

fail in materials or workmanship within specified warranty period.

- B. Warranty Period: **[Five]** <Insert number> year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
1. Luminaires shall withstand the effects of earthquake motions determined in accordance with **[ASCE/SEI 7]** <Insert requirement>.
 2. Luminaires and lamps shall be labeled vibration and shock resistant.
 3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified[**and the luminaire will be fully operational during and after the seismic event**]."
- B. Ambient Temperature: **[41 to 104 deg F]** **[5 to 104 deg F]**.
1. Relative Humidity: Zero to 95 percent.
- C. Altitude: Sea level to **[1000 feet]** <Insert altitude>.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

2.3 MATERIALS

- A. Metal Parts:
1. Free of burrs and sharp corners and edges.
 2. Sheet metal components shall be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Steel:
1. ASTM A36/A36M for carbon structural steel.
 2. ASTM A568/A568M for sheet steel.

- C. Stainless Steel:
 - 1. Manufacturer's standard grade.
 - 2. Manufacturer's standard type, ASTM A240/240M.
- D. Galvanized Steel: ASTM A653/A653M.
- E. Aluminum: ASTM B209.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: **1/2-inch** steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, [**12 gage**] <Insert size>.
- D. Rod Hangers: **3/16-inch** minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. **[Attached to structural members in walls] [Attached to a minimum 20 gauge backing plate attached to wall structural members] [Attached using through bolts and backing plates on either side of wall] <Insert means of attachment>.**
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling Mount:
 - a. **[Two] <Insert number> 5/32-inch- <Insert value> diameter aircraft cable supports [adjustable to] [10 feet in length] <Insert length>.**
 - b. **[Pendant mount] [Four-point pendant mount] with [5/32-inch-] <Insert value> diameter aircraft cable supports [adjustable to] [10 feet in length] <Insert length>.**
 - c. Hook mount.
2. Pendants and Rods: Where longer than **48 inches**, brace to limit swinging.
3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and **[tubing or rod] [wire support]** for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.6 STARTUP SERVICE

- A. Comply with requirements for startup specified in Section 260943.16 "Addressable-Luminaire Lighting Controls."
- B. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within [12] <Insert number> months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to [two] <Insert number> visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Materials.
 - 2. Luminaire support components.

1.2 DEFINITIONS

- A. Correlated Color Temperature (CCT): The absolute temperature, measured in kelvins, of a blackbody whose chromaticity most nearly resembles that of the light source.
- B. Color Rendering Index (CRI): Measure of the degree of color shift that objects undergo when illuminated by the light source as compared with the color of those same objects when illuminated by a reference source.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Lumen (lm): The SI derived unit of luminous flux equal to the luminous flux emitted within a unit solid angle by a unit point source (1 lm = 1 cd-sr).

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - a. Include data on features, accessories, and finishes.
 - b. Include physical description of unit and dimensions.
 - c. Battery and charger for light units.
 - d. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - e. Include photometric data and adjustment factors based on laboratory tests by, or under supervision of, qualified luminaire photometric testing laboratory, for each luminaire type.
- B. Shop Drawings:
 - 1. For nonstandard or custom luminaires.
 - a. Include plans, elevations, sections, and mounting and attachment details.
 - b. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - c. Include diagrams for power, signal, and control wiring.
- C. Sustainable Design Submittals:
 - 1. Product Data: Indicating luminaire is certified by **[ENERGY STAR] [Design Lights Consortium]**.
 - 2. Product Data: For lamps, indicating mercury content and lamp life.
- D. Samples: For each product and for each color and texture specified.

- E. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.
 - F. Samples for Verification: For each type of luminaire.
 - 1. Include Samples of luminaires and accessories to verify finish selection.
 - G. Product Schedule:
 - 1. For emergency lighting units.[**Use same designations indicated on Drawings.**]
 - 2. For exit signs.[**Use same designations indicated on Drawings.**]
- 1.4 INFORMATIONAL SUBMITTALS
- A. Product Certificates: For each type of luminaire.
 - B. Product Test Reports: For each luminaire for tests performed by, or under supervision of, qualified luminaire photometric testing laboratory.
 - C. Sample Warranty: For manufacturer's[**special**] warranty.
- 1.5 MAINTENANCE MATERIAL SUBMITTALS
- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: [**10 for every 100**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.
 - 2. Luminaire-mounted, emergency battery pack: One for every [**20**] [**50**] **<Insert quantity>** emergency lighting units. Furnish at least one of each type.
 - 3. Diffusers and Lenses: [**One for every 100**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: [**One for every 20**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.
- 1.6 QUALITY ASSURANCE
- A. FM Global Compliance: Luminaires for hazardous locations must be listed and labeled for indicated class and division of hazard by FM Global.
 - B. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires and signs in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging completed Work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of completed Work if undisturbed at time of Substantial Completion.
- 1.7 DELIVERY, STORAGE, AND HANDLING
- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.8 WARRANTY

- A. Special Installer Extended Warranty for Emergency and Exit Lighting: Installer warrants that fabricated and installed emergency luminaires and exit signs, including batteries, perform in accordance with specified requirements and agrees to repair or replace components and assemblies that fail to perform as specified within extended warranty period.
 - 1. Extended Warranty Period: [**Two**] <Insert number> year(s) from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty for Batteries for Emergency and Exit Lighting: Manufacturer warrants that batteries for emergency luminaires and exit signs perform in accordance with specified requirements and agrees to provide repair or replacement of batteries that fail to perform as specified within extended warranty period.
 - 1. Extended Warranty Period: [**Five**] <Insert number> year(s) from date of Substantial Completion; [**prorated**] [**full**] coverage for labor, materials, and equipment.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled in accordance with NFPA 70 and UL 924, by qualified electrical testing laboratory recognized by authorities having jurisdiction, and marked for intended location and application.
- B. Comply with NFPA 101.
- C. Comply with NEMA LE 4 for recessed luminaires.
- D. Comply with UL 1598 for fluorescent luminaires.
- E. Lamp Base: Comply with [**ANSI C81.61**] [or] [**IEC 60061-1**].
- F. Bulb Shape: Complying with ANSI C79.1.
- G. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body[**and compatible with ballast**].
 - 1. Emergency Connection: Operate [**one**] <Insert number> lamp(s) continuously at an output of [**1100**] <Insert value> lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 3. Nightlight Connection: Operate lamp continuously at [**40**] <Insert value> percent of rated light output.
 - 4. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

5. Battery: Sealed, maintenance-free, **[nickel-cadmium]** **[lead-acid]** type.
 6. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 7. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- H. External Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
1. Emergency Connection: Operate **[one]** **<Insert number>** **[fluorescent]** **[incandescent]** **[LED]** lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire **[ballast]**.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
 4. Battery: Sealed, maintenance-free, **[nickel-cadmium]** **[lead-acid]** type.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Housing: Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly must be located no less than half of distance recommended by **[ballast]** **[emergency power unit]** manufacturer, whichever is less.
 7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- 2.2 MATERIALS
- A. Metal Parts:
1. Free of burrs and sharp corners and edges.
 2. Sheet metal components must be steel unless otherwise indicated.
 3. Form and support to prevent warping and sagging.
- B. Doors, Frames, and Other Internal Access:
1. Smooth operating, free of light leakage under operating conditions.
 2. Designed to permit relamping without use of tools.
 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. [Tempered Fresnel glass] [Prismatic glass] [Diffuse glass] [Clear glass] [Prismatic acrylic] [Clear, UV-stabilized acrylic].
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
4. Lens Thickness: At least **0.125 inch** minimum unless otherwise indicated.

D. Housings:

1. [Extruded aluminum] <Insert type> housing[and heat sink].
2. [Clear] <Insert color> [anodized] [powder coat] [painted] finish.

E. Conduit: [ERMC] [EMT] [FMC], minimum metric designator 21 (trade size 3/4).

2.3 METAL FINISHES

- A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, [**0.106 inch**] <Insert size>.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- B. Install lamps in each luminaire.
- C. Supports:
1. Sized and rated for luminaire[and emergency power unit] weight.
 2. Able to maintain luminaire position when testing emergency power unit.
 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 4. Luminaire-mounting devices must be capable of supporting a horizontal force of 100

percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.

D. Wall-Mounted Luminaire Support:

1. **[Attached to structural members in walls] [Attached to a minimum 20-gauge backing plate attached to wall structural members] [Attached using through bolts and backing plates on either side of wall] <Insert means of attachment>.**
2. Do not attach luminaires directly to gypsum board.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than **48 inch**, brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and **[tubing or rod] [wire support]** for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Ceiling Grid Mounted Luminaires:

1. Secure to outlet box, if provided.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Field tests and inspections must be witnessed by **[Architect] [Tenant] [authorities having jurisdiction] <Insert names or titles of witnesses>.**
- B. Tests and Inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- C. Nonconforming Work:
1. Luminaire will be considered defective if it does not pass operation tests and inspections.
 2. Remove and replace defective units and retest.
- D. Prepare test and inspection reports.
- E. Manufacturer Services:
1. Engage factory-authorized service representative to **[support] [supervise]** field tests and inspections.

3.5 SYSTEM STARTUP

- A. Perform startup service:
 - 1. Charge [**emergency power units**] [**and**] [**batteries**] minimum of one hour and depress switch to conduct short-duration test.
 - 2. Charge [**emergency power units**] [**and**] [**batteries**] minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

- A. Adjustments: Within [**12**] <**Insert number**> months of date of Substantial Completion, provide on-site visit to do the following:
 - 1. Inspect luminaires. Replace lamps, [**emergency power units**] [, **batteries**,] [**exit signs**,] and luminaires that are defective.
 - a. Parts and supplies must be manufacturer's authorized replacement parts and supplies.
 - 2. Conduct short-duration tests on all emergency lighting.

3.7 PROTECTION

- A. Remove and replace luminaires and exit signs that are damaged or caused to be unfit for use by construction activities.

END OF SECTION 265213

SECTION 265619 - LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Materials.
 - 2. Finishes.
 - 3. Luminaire support components.

1.2 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaire.
 - 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Photometric data and adjustment factors based on laboratory tests, complying with **[IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project] [IES LM-79] [IES LM-80]**.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 - 6. Wiring diagrams for power, control, and signal wiring.
 - 7. Photoelectric relays.
 - 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.

- C. Sustainable Design Submittals:
 - 1. BUG Ratings: Product Data indicating BUG ratings of all installed exterior luminaires.
 - 2. BUG Ratings: Provide luminaire cut sheets indicating backlight, uplight, and glare, based on the specific light source installed at luminaire location.
 - 3. Luminaire Calculations: Product Data indicating lumen emittance and vertical illuminance.
 - 4. Product Data: Indicating luminaire is certified by **[ENERGY STAR] [Design Lights Consortium]**.
 - D. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
 - E. Product Schedule: For luminaires and lamps. **[Use same designations indicated on Drawings.]**
 - F. Delegated Design Submittals: For luminaire supports.
 - 1. Include design calculations for luminaire supports **[and seismic restraints]**.
- 1.4 INFORMATIONAL SUBMITTALS
- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Structural members to which **[equipment] [and]** luminaires will be attached.
 - 3. Underground utilities and structures.
 - 4. Existing underground utilities and structures.
 - 5. Above-grade utilities and structures.
 - 6. Existing above-grade utilities and structures.
 - 7. Building features.
 - 8. Vertical and horizontal information.
 - 9. **<Insert feature>**.
 - B. Qualification Data: For testing laboratory providing photometric data for luminaires.
 - C. Seismic Qualification Data: For luminaires, accessories, and 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 the certification is based and their installation requirements.
 - D. Product Certificates: For each type of the following:
 - 1. Luminaire.
 - 2. Photoelectric relay.
 - E. Product Test Reports: For each luminaire, for tests performed by **[manufacturer and witnessed by a qualified testing agency] [a qualified testing agency]**.
 - F. Source quality-control reports.

- G. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires [**and photoelectric relays**] to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

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. Lamps: [**Ten for every 100**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: [**One for every 100**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: [**One for every 100**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: [**One for every 20**] **<Insert quantity>** of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications:
 - 1. Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.
 - 2. Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- E. Mockups: For exterior luminaires, complete with power and control connections.
 - 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.9 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - d. **<Insert failure modes>**.
 - 2. Warranty Period: [2] **<Insert number>** year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance:
 - 1. Luminaires shall withstand the effects of earthquake motions determined according to **[ASCE/SEI 7] <Insert requirement>**.
 - 2. Luminaires and lamps shall be labeled vibration and shock resistant.
 - 3. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified[**and the luminaire will be fully operational during and after the seismic event**]."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598[**and listed for wet location**].
- E. Lamp base complying with **[ANSI C81.61] [or] [IEC 60061-1]**.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of **[minimum] [65] [70] [80] <Insert number>**. CCT of **[2700 K] [3000 K] [4100 K] <Insert value>**.
- H. L70 lamp life of **[35,000] [50,000] <Insert number>** hours.

- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: [120 V ac] [240 V ac] [277 V ac] [12 V dc] [24 V dc].
- L. In-line Fusing: [On the primary for each luminaire] [Separate in-line fuse for each luminaire].
- M. Lamp Rating: Lamp marked for [outdoor use] [and] [in enclosed locations].
- N. Source Limitations:
 - 1. Obtain luminaires from single source from a single manufacturer.
 - 2. For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: [Corrosion-resistant aluminum] [Stainless steel] [Epoxy-coated steel] <Insert material>. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 - 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
 - 3. Lens Thickness: At least **0.125 inch** minimum unless otherwise indicated.
- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal

viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.4 FINISHES

- A. Variations in Finishes: 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.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
 - a. Color: **[Light bronze]** **[Medium bronze]** **[Dark bronze]** **[Black]** **<Insert color>**.
- D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
 2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color:
 - 1) As selected from manufacturer's standard catalog of colors.
 - 2) Match Architect's sample of **[manufacturer's standard]** **[custom]** color.
 - 3) As selected by Architect from manufacturer's full range.

2.5 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, **[and] [canopy ceilings] [and] [overhang ceilings]** for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. **[Attached to structural members in walls] [Attached to a minimum 1/8 inch backing plate attached to wall structural members] [Attached using through bolts and backing plates on either side of wall] <Insert means of attachment>.**
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. **[Install luminaires level, plumb, and square with finished grade unless otherwise indicated.] [Install luminaires at height and aiming angle as indicated on Drawings.]**
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. **[Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring**

a north orientation.]

- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533.13 "Conduits for Electrical Systems" for wiring connections and wiring methods.

3.4 INSTALLATION OF BOLLARD LUMINAIRES

- A. Align units for optimum directional alignment of light distribution.
 - 1. Install on concrete base with top [**4 inches**] <Insert dimension> above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.
- B. Install on concrete base with top [**4 inches**] <Insert dimension> above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533.13 "Conduits for Electrical Systems." In concrete foundations, wrap conduit with **0.010-inch**- thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections[**with the assistance of a factory-authorized service representative**]:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Photoelectric Control Operation: Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.

2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - D. Luminaire will be considered defective if it does not pass tests and inspections.
 - E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.
- 3.9 DEMONSTRATION
- A. **[Engage a factory-authorized service representative to train] [Train]** Owner's maintenance personnel to adjust, operate, and maintain luminaires[**and photocell relays**].
- 3.10 ADJUSTING
- A. Occupancy Adjustments: When requested within **[12] <Insert number>** months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to **[two] <Insert number>** visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 3. Adjust the aim of luminaires in the presence of Architect.

END OF SECTION 265619

SECTION 311000 - SITE CLEARING

PART 1 - GENERAL

1.1 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.

1.2 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** 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.

1.3 PREINSTALLATION MEETINGS

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

1.4 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.

1.5 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.

1.6 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.

1.7 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
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**] [**3 inches**] **<Insert dimension>** in diameter, obstructions, and debris to a depth of [**18 inches**] **<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**, 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**] **<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** 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**] <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**] <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** 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**] <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

PART 4 - GENERAL

4.1 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 311000 "Site Clearing" for site stripping, grubbing, stripping[**and stockpiling**] topsoil, and removal of above- and below-grade improvements and utilities.
3. Section 315000 "Excavation Support and Protection" for shoring, bracing, and sheet piling of excavations.
4. Section 316329 "Drilled Concrete Piers and Shafts" for excavation of shafts and disposal of surplus excavated material.
5. Section 329200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.
6. Section 329300 "Plants" for finish grading in planting areas and tree and shrub pit excavation and planting.

4.2 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] <Insert dimension> outside of concrete forms other than at footings.
 - 2. [12 inches] <Insert dimension> outside of concrete forms at footings.
 - 3. [6 inches] <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] <Insert dimension> beneath bottom of concrete slabs-on-grade.
 - 6. [6 inches] <Insert dimension> beneath pipe in trenches, and the greater of [24 inches] <Insert dimension> wider than pipe or [42 inches] <Insert dimension> wide.

4.3 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] <Insert dimension> in width and more than [30 feet] <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, will be without additional compensation.
- G. Fill: Soil materials used to raise existing grades.
- H. Rock:

rock material that exceed [**1 cu. yd.**] **<Insert volume>** for bulk excavation or [**3/4 cu. yd.**] **<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:

- a. Equipment for Footing, Trench, and Pit Excavation: Late-model, track-mounted hydraulic excavator; equipped with a **42-inch-** maximum-width, short-tip-radius rock bucket; rated at not less than **138-hp** flywheel power with bucket-curling force of not less than **28,700 lbf** and stick-crowd force of not less than **18,400 lbf** with extra-long reach boom.
 - b. Equipment for Bulk Excavation: Late-model, track-mounted loader; rated at not less than **230-hp** flywheel power and developing a minimum of **47,992-lbf** breakout force with a general-purpose bare bucket.
2. Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material [**3/4 cu. yd.**] **<Insert volume>** or more in volume that exceed a standard penetration resistance of [**100 blows/2 inches**] **<Insert value>** when tested by a geotechnical testing agency, according to ASTM D1586.
- I. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other fabricated stationary features constructed above or below the ground surface.
- J. 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.
- K. 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.
- L. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.
- 4.4 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>**.

4.5 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. Geofoam.
 - 4. Warning tapes.
- B. Samples for Verification: For the following products, in sizes indicated below:
 - 1. Geotextile: **12 by 12 inches**.
 - 2. Warning Tape: **12 inches** long; of each color.

4.6 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 D2487.
 - 2. Laboratory compaction curve according to [**ASTM D698**] [**ASTM D1557**].
- 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.

4.7 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 E329 and ASTM D3740 for testing indicated.

4.8 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 5 - PRODUCTS

PART 6 - EXECUTION

6.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by
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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.

6.2 DEWATERING

- A. Provide dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.
- B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- C. 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.
- D. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

6.3 EXPLOSIVES

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

6.4 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] <Insert dimension> outside of concrete forms other than at footings.
 - b. [12 inches] <Insert dimension> outside of concrete forms at footings.
 - c. [6 inches] <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] <Insert dimension> beneath bottom of concrete slabs-on-grade.
 - f. [6 inches] <Insert dimension> beneath pipe in trenches and the greater of [24 inches] <Insert dimension> wider than pipe or [42 inches] <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] <Insert dimension> outside of concrete forms other than at footings.
 - b. [12 inches] <Insert dimension> outside of concrete forms at footings.
 - c. [6 inches] <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] <Insert dimension> beneath bottom of concrete slabs-on-grade.
 - f. [6 inches] <Insert dimension> beneath pipe in trenches and the greater of [24 inches] <Insert dimension> wider than pipe or [42 inches] <Insert dimension> wide.

6.5 EXCAVATION FOR STRUCTURES

- A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus **1 inch**. 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** 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**. 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."

6.6 EXCAVATION FOR WALKS AND PAVEMENTS

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

6.7 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** higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: [**12 inches each side of pipe or conduit**] [**As indicated**].

C. Trench Bottoms:

1. 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.
 - a. For pipes and conduit less than **6 inches** in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
 - b. For pipes and conduit **6 inches** 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.
 - c. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
 - d. Excavate trenches **6 inches** deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2. Excavate trenches **4 inches** deeper than bottom of pipe and conduit elevations to allow for
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bedding course. Hand-excavate deeper for bells of pipe.

- a. Excavate trenches **6 inches** deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. 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."

6.8 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.

6.9 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**] <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**.
 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.

6.10 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**, may be used when approved by Architect.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

6.11 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.

6.12 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.

6.13 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**] <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."
- D. Trenches under Roadways: Provide [**4-inch-**] <Insert dimension> thick, concrete-base slab support for piping or conduit less than [**30 inches**] <Insert dimension> below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of [**4 inches**] <Insert dimension> of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 033000 "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] <Insert dimension> in any dimension, to a height of **12 inches** 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** 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** below finished grade, except **6 inches** below subgrade under pavements and slabs.

6.14 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.

6.15 GEOFOAM FILL

- A. Place a leveling course of sand, [**2 inches**] <Insert dimension> thick, over subgrade. Finish leveling course to a tolerance of **1/2 inch** when tested with a **10-foot** 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.

6.16 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.

6.17 COMPACTION OF SOIL BACKFILLS AND FILLS

- A. Place backfill and fill soil materials in layers not more than **[8 inches] <Insert dimension>** in loose depth for material compacted by heavy compaction equipment and not more than **4 inches** 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 D698] [ASTM D1557]**:
 - 1. Under structures, building slabs, steps, and pavements, scarify and recompact top **12 inches** 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** 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** 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.

6.18 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] <Insert dimension>**.

2. Walks: Plus or minus [**1 inch**] <Insert dimension>.
 3. Pavements: Plus or minus [**1/2 inch**] <Insert dimension>.
- C. Grading inside Building Lines: Finish subgrade to a tolerance of [**1/2 inch**] <Insert dimension> when tested with a **10-foot** straightedge.

6.19 SUBSURFACE DRAINAGE

- A. Subsurface Drain: Place subsurface drainage geotextile around perimeter of subdrainage trench. Place a **6-inch** course of filter material on subsurface drainage geotextile to support subdrainage pipe. Encase subdrainage pipe in a minimum of **12 inches** of filter material, placed in compacted layers **6 inches** thick, and wrap in subsurface drainage geotextile, overlapping sides and ends at least **6 inches**.
1. Compact each filter material layer [**to 85 percent of maximum dry unit weight according to ASTM D698**] [**with a minimum of two passes of a plate-type vibratory compactor**].
- B. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within **12 inches** of final subgrade, in compacted layers **6 inches** thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least **6 inches**.
1. Compact each filter material layer [**to 85 percent of maximum dry unit weight according to ASTM D698**] [**with a minimum of two passes of a plate-type vibratory compactor**].
 2. Place and compact impervious fill over drainage backfill in **6-inch-** thick compacted layers to final subgrade.

6.20 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** or less in compacted thickness in a single layer.
 5. Place subbase course[**and base course**] that exceeds **6 inches** in compacted thickness in layers of equal thickness, with no compacted layer more than **6 inches** thick or less than **3 inches** 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 D698**] [**ASTM D1557**].
- C. Pavement Shoulders: Place shoulders along edges of subbase course[**and base course**] to prevent lateral movement. Construct shoulders, at least **12 inches** 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 D698**] [**ASTM D1557**].

6.21 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** or less in compacted thickness in a single layer.
 - 3. Place drainage course that exceeds **6 inches** in compacted thickness in layers of equal thickness, with no compacted layer more than **6 inches** thick or less than **3 inches** 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 D698.

6.22 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 D1556, ASTM D2167, ASTM D2937, and ASTM D6938, 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.] <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] <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] <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.

6.23 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.

6.24 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 312319 - DEWATERING

PART 7 - GENERAL

7.1 SUMMARY

- A. Section Includes:
 - 1. Construction dewatering.
- B. Related Requirements:

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1. Section 013233 "Photographic Documentation" for recording preexisting conditions and dewatering system progress.
2. Section 015723 "Temporary Storm Water Pollution Control" for temporary storm water pollution controls mandated under the EPA's National Pollutant Discharge Elimination System.
3. Section 312000 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

7.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.
 1. Dewatering observation wells are part of [**dewatering**] **<Insert description>** allowance.

7.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] **<Insert location>**.
 1. Verify availability of Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 2. Review condition of site to be dewatered, including coordination with temporary erosion-control measures and temporary controls and protections.
 3. Review geotechnical report.
 4. Review proposed site clearing and excavations.
 5. Review existing utilities and subsurface conditions.
 6. Review observation and monitoring of dewatering system.

7.4 ACTION SUBMITTALS

- A. Shop Drawings: For dewatering 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 wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
 3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
 4. Include written plan for dewatering operations, including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.
- B. Delegated Design Submittals: For dewatering system, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

7.5 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Submittals:
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1. Field quality-control reports.
- B. Qualification Statements: For **[Installer]** **[and]** **[land surveyor]** **<Insert entity or specialist>**.
- C. Delegated design engineer qualifications.
- D. Existing Conditions: Using **[photographs]** **[or]** **[video recordings]**, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.
- E. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

7.6 QUALITY ASSURANCE

- A. Qualifications:
 1. Installer: An experienced installer that has specialized in **[design of dewatering systems and]** dewatering work.
 2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in **[state]** **<Insert jurisdiction>** where Project is located and who is experienced in providing engineering services of the type indicated.
 3. Land Surveyor: A professional land surveyor who is legally qualified to practice in **[state]** **<Insert jurisdiction>** where Project is located.

7.7 FIELD CONDITIONS

- A. 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 this data.
 1. Make additional test borings and conduct other exploratory operations necessary for dewatering in accordance with the performance requirements.
 2. The geotechnical report is **[included]** **[referenced]** elsewhere in Project Manual.
- B. 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 8 - PRODUCTS

PART 9 - EXECUTION

9.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or groundwater from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
 2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.
- B. Install dewatering system 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. Provide temporary grading to facilitate dewatering and control of surface water.
- D. Protect and maintain temporary erosion and sedimentation controls, which are specified in [Section 015000 "Temporary Facilities and Controls,"] [Section 015723 "Temporary Storm Water Pollution Control"] [Section 311000 "Site Clearing,"] during dewatering operations.

9.2 INSTALLATION

- A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.
1. Space well points or wells at intervals required to provide sufficient dewatering.
 2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.
- B. Place dewatering system into operation to lower water to specified levels before excavating below groundwater level.
- C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.
- D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

9.3 OPERATION

- A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.
- B. Operate system to lower and control groundwater to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.
1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
 2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.
 3. Maintain piezometric water level a minimum of **[24 inches] [60 inches] <Insert dimension>** below bottom of excavation.

- C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.
- D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of **36 inches** below overlying construction.

9.4 FIELD QUALITY CONTROL

- A. Observation Wells: Provide observation wells or piezometers, take measurements, and maintain at least the minimum number indicated; additional observation wells may be required by authorities having jurisdiction.
 - 1. Observe and record daily elevation of groundwater and piezometric water levels in observation wells.
 - 2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.
 - 3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.
- B. Survey-Work Benchmarks: Resurvey benchmarks **[regularly]** **[monthly]** **<Insert time period>** during dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.
- D. Prepare reports of observations.

9.5 PROTECTION

- A. Protect and maintain dewatering system during dewatering operations.
- B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION 312319

SECTION 315000 - EXCAVATION SUPPORT AND PROTECTION

PART 10 - GENERAL

10.1 SUMMARY

- A. Section includes temporary excavation support and protection systems.
- B. Related Requirements:

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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, for controlling surface-water runoff and ponding, and for dewatering excavations.

10.2 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.

10.3 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.
- C. Delegated-Design Submittal: For excavation support and protection systems, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

10.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
1. Land surveyor.
 2. Professional Engineer: Experience with providing delegated-design engineering services of the type indicated, including documentation that engineer is licensed in the **[jurisdiction]** **[state]** in which Project is located.
- 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.

10.5 CLOSEOUT SUBMITTALS

- A. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

10.6 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. 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 11 - PRODUCTS

PART 12 - EXECUTION

12.1 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.

12.2 INSTALLATION - GENERAL

- A. Locate excavation support and protection systems clear of permanent construction, so that construction and finishing of other work is not impeded.
- 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.

2. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
- C. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.

12.3 SOLDIER PILES AND LAGGING

- A. Install steel soldier piles before starting excavation.
 1. Extend soldier piles below excavation grade level to depths adequate to prevent lateral movement.
 2. Space soldier piles at regular intervals not to exceed allowable flexural strength of wood lagging.
 3. Accurately align exposed faces of flanges to vary not more than [**2 inches 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.
 1. Trim excavation as required to install lagging.
 2. Fill voids behind lagging with soil, and compact.
- C. Install wales horizontally at locations indicated on Drawings and secure to soldier piles.

12.4 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.
 1. Limit vertical offset of adjacent sheet piling to **60 inches**.
 2. Accurately align exposed faces of sheet piling to vary not more than [**2 inches 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.

12.5 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.

12.6 BRACING

- A. 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.

12.7 MAINTENANCE

- A. Monitor and maintain excavation support and protection system.
- B. Prevent surface water from entering excavations by grading, dikes, or other means.
- C. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

12.8 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.
 - 1. Maintain an accurate log of surveyed elevations and positions for comparison with original elevations and positions.
 - 2. 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.

12.9 REMOVAL AND REPAIRS

- A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures.
 - 1. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.
 - 2. Remove excavation support and protection systems to a minimum depth of [48] <Insert dimension> inches below overlying construction, and abandon remainder.
 - 3. Fill voids immediately with approved backfill compacted to density specified in Section 312000 "Earth Moving."
 - 4. 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 321313 - CONCRETE PAVING

PART 13 - GENERAL

13.1 SUMMARY

- A. Section includes concrete paving[.][**including the following:**]
1. Driveways.
 2. Roadways.
 3. Parking lots.
 4. Curbs and gutters.
 5. Walks.
- B. Related Requirements:
1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
 2. Section 321316 "Decorative Concrete Paving" for stamped concrete other than stamped detectable warnings.
 3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
 4. Section 321713 "Parking Bumpers."
 5. Section 321716 "Manufactured Traffic-Calming Devices."
 6. Section 321723 "Pavement Markings."
 7. Section 321726 "Tactile Warning Surfacing" for detectable warning [**tiles**] [**mats**] [**and**] [**pavers**].

13.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

13.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.
1. Review methods and procedures related to concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and concrete paving construction practices.

- c. **<Insert agenda item>.**
- 2. Require representatives of each entity directly concerned with concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete paving Subcontractor.
 - e. Manufacturer's representative of stamped concrete paving system used for stamped detectable warnings.

13.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Environmental Product Declaration (EPD): For each product.
 - 4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
 - 5. Environmental Product Declaration: For each product.
 - 6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
 - 7. Environmental Product Declaration: For each product.
 - 8. Environmental Product Declaration: For each product.
 - 9. Third-Party Certifications: For each product.
 - 10. Third-Party Certified Life Cycle Assessment: For each product.
 - 11. Laboratory Test Reports: For concrete paving mixtures, documentation indicating that cured concrete complies with Solar Reflectance Index requirements.
 - 12. Laboratory Test Reports: For concrete paving mixtures, documentation indicating that cured concrete complies with Solar Reflectance Index requirements.
- C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color selection.
- D. Samples for Verification: For each type of product or exposed finish, prepared as Samples of size indicated below:
 - 1. Exposed Aggregate: **[10-lb]** **<Insert weight>** Sample of each mix.
- E. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

13.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Installer of stamped detectable warnings**] [**ready-mix concrete manufacturer**] [**and**] [**testing agency**].
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:
 - 1. Aggregates: [**Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.**]
- D. Field quality-control reports.

13.6 QUALITY ASSURANCE

- A. Stamped Detectable Warning Installer Qualifications: An employer of workers trained and approved by manufacturer of stamped concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockups of full-thickness sections of concrete paving to demonstrate typical joints; surface finish, texture, and color; curing; and standard of workmanship.
 - 2. Build mockups of concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than [**96 inches by 96 inches**] <Insert dimensions>.[**Include full-size detectable warning.**]
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

13.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on concrete paving mixtures.

13.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
 1. When air temperature has fallen to or is expected to fall below **40 deg F**, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than **50 deg F** and not more than **80 deg F** at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with **ACI 301** and as follows when hot-weather conditions exist:
 1. Cool ingredients before mixing to maintain concrete temperature below **90 deg F** at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms[, **steel reinforcement**,] and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 14 - PRODUCTS

14.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with **ACI 301** unless otherwise indicated.

14.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.

1. Use flexible or uniformly curved forms for curves with a radius of **100 feet** or less.[**Do not**

use notched and bent forms.]

- B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

14.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] [60] <Insert value>** percent.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from **[as-drawn] [galvanized-]** steel wire into flat sheets.
- C. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.
- D. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.
- E. Reinforcing Bars: ASTM A615/A615M, **Grade 60**; deformed.
- F. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, **Grade 60** deformed bars.
- G. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, **Grade 60** deformed bars.
- H. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, **Grade 60** deformed bars; assembled with clips.
- I. Plain-Steel Wire: ASTM A1064/A1064M, **[as drawn] [galvanized]**.
- J. Deformed-Steel Wire: ASTM A1064/A1064M.
- K. Epoxy-Coated-Steel Wire: ASTM A884/A884M, Class A; coated, **[plain] [deformed]**.
- L. Joint Dowel Bars: ASTM A615/A615M, **Grade 60** plain-steel bars[; **zinc coated (galvanized) after fabrication according to ASTM A767/A767M, Class I coating**]. Cut bars true to length with ends square and free of burrs.
- M. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, **Grade 60** plain-steel bars.
- N. Tie Bars: ASTM A615/A615M, **Grade 60**; deformed.
- O. Hook Bolts: **ASTM A307, Grade A**, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- P. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
- Q. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.
- R. Zinc Repair Material: ASTM A780/A780M.

14.4 CONCRETE MIXTURES

- A. Prepare design mixtures, proportioned according to **ACI 301**, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
 2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.
- B. Cementitious Materials:[**Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.**][**Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:**]
1. Fly Ash or Pozzolan: 25 percent.
 2. Slag Cement: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content, **1-1/2-inch** Nominal Maximum Aggregate Size: **[5-1/2] [4-1/2] [2-1/2]** percent plus or minus 1-1/2 percent.
 2. Air Content, **1-inch** Nominal Maximum Aggregate Size: **[6] [4-1/2] [3]** percent plus or minus 1-1/2 percent.
 3. Air Content, **3/4-inch** Nominal Maximum Aggregate Size: **[6] [5] [3-1/2]** percent plus or minus 1-1/2 percent.
- D. Limit water-soluble, chloride-ion content in hardened concrete to **[0.15] [0.30]** percent by weight of cement.
- E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use **[water-reducing admixture] [high-range, water-reducing admixture] [high-range, water-reducing and retarding admixture] [plasticizing and retarding admixture]** in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but
- LED EXTERIOR LIGHTING

not less than [1.0 lb/cu. yd.] [1.5 lb/cu. yd.] <Insert requirement>.

- G. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- H. Concrete Mixtures: Normal-weight concrete.
 - 1. Compressive Strength (28 Days): [4500 psi] [4000 psi] [3500 psi] [3000 psi] <Insert strength>.
 - 2. Maximum W/C Ratio at Point of Placement: [0.45] [0.50] <Insert ratio>.
 - 3. Slump Limit: [4 inches] [5 inches] [8 inches] <Insert dimension>, plus or minus 1 inch.
 - 4. Solar Reflectance Index: Not less than 29.
 - 5. Solar Reflectance (SR): Three-year-aged SR value of at least 0.28 or initial SR of at least 0.33.
 - 6. Solar Reflectance (SR): At least 0.30.
 - 7. Solar Reflectance Index: At least 25.

14.5 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M[and ASTM C1116/C1116M]. Furnish batch certificates for each batch discharged and used in the Work.
 - 1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
 - 1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
 - 2. For concrete batches larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
 - 3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 15 - EXECUTION

15.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below [concrete paving] <Insert locations> to identify soft pockets and areas of excess yielding.
 - 1. Completely proof-roll subbase in one direction[and repeat in perpendicular direction]. Limit vehicle speed to 3 mph.

2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than **15 tons**.
 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of [**1/2 inch**] **<Insert dimension>** according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

15.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.

15.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

15.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.
- F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.
- G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum **2-inch** overlap of adjacent mats.

15.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline

unless otherwise indicated.

1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Butt Joints: Use [**bonding agent**] [**epoxy-bonding adhesive**] at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least **1-1/2 inches** into concrete.
 5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
1. Locate expansion joints at intervals of [**50 feet**] **<Insert dimension>** unless otherwise indicated.
 2. Extend joint fillers full width and depth of joint.
 3. Terminate joint filler not less than **1/2 inch** or more than **1 inch** below finished surface if joint sealant is indicated.
 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows[, **to match jointing of existing adjacent concrete paving**]:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a [**1/4-inch**] [**3/8-inch**] radius. Repeat grooving of contraction joints after applying surface finishes.[**Eliminate grooving-tool marks on concrete surfaces.**]
 - a. Tolerance: Ensure that grooved joints are within [**3 inches**] **<Insert dimension>** either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch**-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

- a. Tolerance: Ensure that sawed joints are within [**3 inches**] <Insert dimension> either way from centers of dowels.
- 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a [**1/4-inch**] [**3/8-inch**] radius. Repeat tooling of edges after applying surface finishes. [**Eliminate edging-tool marks on concrete surfaces.**]

15.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation[, **steel reinforcement**,] and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface[**and steel reinforcement**] before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with **ACI 301** requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to **ACI 301** by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 - 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies[, **reinforcement**,] or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating [**reinforcement**] [**dowels**] [**and**] joint devices.
- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.
- J. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.
- K. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
 - 1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-

form paving machine during operations.

15.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface **1/16 to 1/8 inch** deep with a stiff-bristled broom, perpendicular to line of traffic.

15.8 SPECIAL FINISHES

- A. Monolithic Exposed-Aggregate Finish: Expose coarse aggregate in paving surface as follows:
 - 1. Immediately after float finishing, spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 - 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove when ready to continue finishing operations.
 - 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
 - 4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.
- B. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of **1/16 inch**.
 - 1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
 - 2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
 - 3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
 - 4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

- C. Slip-Resistive Aggregate Finish: Before final floating, spread slip-resistive aggregate finish on paving surface according to manufacturer's written instructions and as follows:
1. Uniformly spread [**25 lb/100 sq. ft.**] [**40 lb/100 sq. ft.**] [**60 lb/100 sq. ft.**] <Insert rate of application> of dampened, slip-resistive aggregate over paving surface in two applications. Tamp aggregate flush with surface using a steel trowel, but do not force below surface.
 2. Uniformly distribute approximately two-thirds of slip-resistive aggregate over paving surface with mechanical spreader, allow to absorb moisture, and embed by power floating. Follow power floating with a second slip-resistive aggregate application, uniformly distributing remainder of material at right angles to first application to ensure uniform coverage, and embed by power floating.
 3. Cure concrete with curing compound recommended by slip-resistive aggregate manufacturer. Apply curing compound immediately after final finishing.
 4. After curing, lightly work surface with a steel-wire brush or abrasive stone and water to expose nonslip aggregate.
- D. Rock-Salt Finish: After initial [**floating**] [**troweling**] [**brooming**], uniformly spread rock salt over paving surface at the rate of **5 lb/100 sq. ft.**
1. Embed rock salt into plastic concrete with [**roller**] [**or**] [**magnesium float**] <Insert tool>.
 2. Cover paving surface with **1-mil-** thick polyethylene sheet and remove sheet when concrete has hardened and seven-day curing period has elapsed.
 3. After seven-day curing period, saturate concrete with water and broom-sweep surface to dissolve remaining rock salt, thereby leaving pits and holes.
- E. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surface according to manufacturer's written instructions and as follows:
1. Uniformly spread dry-shake hardener at a rate of [**100 lb/100 sq. ft.**] <Insert rate of application> unless greater amount is recommended by manufacturer to match paving color required.
 2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
 3. After final power floating, apply a hand-troweled finish followed by a broom finish.
 4. Cure concrete with curing compound recommended by dry-shake hardener manufacturer. Apply curing compound immediately after final finishing.

15.9 INSTALLATION OF DETECTABLE WARNINGS

- A. Blockouts: Form blockouts in concrete for installation of detectable paving units specified in Section 321726 "Tactile Warning Surfacing."
1. Tolerance for Opening Size: [Plus **1/4 inch**, no minus] <Insert requirement>.
- B. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning

Surfacing" immediately after screeding concrete surface.

- C. Stamped Detectable Warnings: Install stamped detectable warnings as part of a continuous concrete paving placement and according to stamp-mat manufacturer's written instructions.
1. Before using stamp mats, verify that the vent holes are unobstructed.
 2. Apply liquid release agent to the concrete surface and the stamp mat.
 3. Stamping: [**While initially finished concrete is plastic**] [**After application and final floating of pigmented mineral dry-shake hardener**], accurately align and place stamp mats in sequence. Uniformly load, gently vibrate, and press mats into concrete to produce imprint pattern on concrete surface. Load and tamp mats directly perpendicular to the stamp-mat surface to prevent distortion in shape of domes. Press and tamp until mortar begins to come through all of the vent holes. Gently remove stamp mats.
 4. Trimming: After [**24**] <Insert number> hours, cut off the tips of mortar formed by the vent holes.
 5. Remove residual release agent according to manufacturer's written instructions, but no fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

15.10 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
- B. Comply with ACI 306.1 for cold-weather protection.
- C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching **0.2 lb/sq. ft. x h** before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
- D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
- E. Curing Methods: Cure concrete by [**moisture curing**] [**moisture-retaining-cover curing**] [**curing compound**] [**or**] [**a combination of these**] as follows:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with **12-inch** lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least **12 inches**, and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller

according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

15.11 PAVING TOLERANCES

A. Comply with tolerances in **ACI 117** and as follows:

1. Elevation: **3/4 inch**.
2. Thickness: Plus **3/8 inch**, minus **1/4 inch**.
3. Surface: Gap below **10-feet-** long; unleveled straightedge not to exceed **1/2 inch**.
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: **1/2 inch per 12 inches** of tie bar.
5. Lateral Alignment and Spacing of Dowels: **1 inch**.
6. Vertical Alignment of Dowels: **1/4 inch**.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: **1/4 inch per 12 inches** of dowel.
8. Joint Spacing: **3 inches**.
9. Contraction Joint Depth: Plus **1/4 inch**, no minus.
10. Joint Width: Plus **1/8 inch**, no minus.

15.12 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each [**100 cu. yd.**] [**5000 sq. ft.**] or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is **40 deg F** and below and when it is **80 deg F** and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test to be the average compressive strength from two

specimens obtained from same composite sample and tested at 28 days.

- C. Strength of each concrete mixture will be satisfactory if 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**.
- D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency will make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

15.13 REPAIR AND PROTECTION

- A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.
- C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321316 - DECORATIVE CONCRETE PAVING

PART 16 - GENERAL

16.1 SUMMARY

A. Section Includes:

1. Colored concrete paving.
2. Stamped concrete paving.
3. Stenciled concrete paving.
4. Stained concrete paving.

B. Related Requirements:

1. **[Section 033000 "Cast-in-Place Concrete"] [Section 033053 "Miscellaneous Cast-in-Place Concrete"]** for general building applications of concrete.
2. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, and stamped detectable warnings.
3. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and other paving or adjacent construction.

16.2 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.
- B. W/C Ratio: The ratio by weight of water to cementitious materials.

16.3 PREINSTALLATION MEETINGS

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

1. Review methods and procedures related to decorative concrete paving, including but not limited to, the following:
 - a. Concrete mixture design.
 - b. Quality control of concrete materials and decorative concrete paving construction practices.
 - c. <**Insert agenda item**>.
2. Require representatives of each entity directly concerned with decorative concrete paving to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Decorative concrete paving Installer.
 - e. Manufacturer's representative of decorative concrete paving system.

16.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 - 2. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
 - 3. Environmental Product Declaration (EPD): For each product.
 - 4. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
 - 5. Environmental Product Declaration: For each product.
 - 6. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
 - 7. Environmental Product Declaration: For each product.
 - 8. Environmental Product Declaration: For each product.
 - 9. Third-Party Certifications: For each product.
 - 10. Third-Party Certified Life Cycle Assessment: For each product.
- C. Samples for Initial Selection: For each type of product, ingredient, or admixture requiring color, pattern, or texture selection.
- D. Samples for Verification: For each type of exposed color, pattern, or texture indicated.
- E. Design Mixtures: For each decorative concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

16.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified [**Installer**] [**ready-mix concrete manufacturer**] [**and**] [**testing agency**].
- B. Material Certificates: For the following, from manufacturer:
 - 1. Cementitious materials.
 - 2. Steel reinforcement and reinforcement accessories.
 - 3. Fiber reinforcement.
 - 4. Admixtures.
 - 5. Curing compounds.
 - 6. Applied finish materials.
 - 7. Bonding agent or epoxy adhesive.
 - 8. Joint fillers.
- C. Material Test Reports: For each of the following:

- 1. Aggregates. [**Include service-record data indicating absence of deleterious expansion of**
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concrete due to alkali-aggregate reactivity.]

- D. Field quality-control reports.

16.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.
- B. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").
- C. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
- D. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.
 2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Architect and not less than **[96 inches by 96 inches]** <Insert dimensions>.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

16.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing on decorative concrete paving mixtures.

16.8 FIELD CONDITIONS

- A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.
- B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:

1. When air temperature has fallen to or is expected to fall below **40 deg F**, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than **50 deg F** and not more than **80 deg F** at point of placement.
 2. Do not use frozen materials or materials containing ice or snow.
 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.
- C. Hot-Weather Concrete Placement: Comply with **ACI 301** and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below **90 deg F** at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms[, **steel reinforcement**,] and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 17 - PRODUCTS

17.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with **ACI 301** unless otherwise indicated.

17.2 FORMS

- A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
1. Use flexible or uniformly curved forms for curves of a radius of **100 feet** or less. [**Do not use notched and bent forms.**]
- B. Forms for Textured Finish Concrete: Units of face design, size, arrangement, and configuration indicated. Provide solid backing and form supports to ensure stability of textured form liners.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

17.3 STEEL REINFORCEMENT

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than **[25] [60] <Insert value>** percent.
- B. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as-drawn steel wire into flat sheets.
- C. Reinforcing Bars: ASTM A615/A615M, **Grade 60**; deformed.

- D. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, **Grade 60** deformed bars; assembled with clips.
- E. Plain-Steel Wire: ASTM A1064/A1064M, as drawn.
- F. Joint Dowel Bars: ASTM A615/A615M, **Grade 60** plain-steel bars. Cut bars true to length with ends square and free of burrs.
- G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded-wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
 - 1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

17.4 RELATED MATERIALS

- A. Joint Fillers: [**ASTM D1751, asphalt-saturated cellulosic fiber**] [**ASTM D1752, cork or self-expanding cork**] [or] [**ASTM D8139, semirigid, closed-cell polypropylene foam**] in preformed strips.
- B. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy-Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin capable of humid curing and bonding to damp surfaces; of class suitable for application temperature, of grade complying with requirements, and of the following types:
 - 1. [**Types I and II, nonload bearing**] [**Types IV and V, load bearing**], for bonding hardened or freshly mixed concrete to hardened concrete.
- D. Polyethylene Film: ASTM D4397, **1 mil** thick, clear.

17.5 CONCRETE MIXTURES

- A. Obtain each color, size, type, and variety of concrete mixture from single manufacturer with resources to provide concrete of consistent quality in appearance and physical properties.
- B. Prepare design mixtures, proportioned according to **ACI 301**, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
- C. Cementitious Materials:[**Use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.**][**Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:**]
 - 1. Fly Ash or Pozzolan: 25 percent.

2. Slag Cement: 50 percent.
 3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.
- D. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
1. Air Content:
 - a. [5-1/2] [4-1/2] [2-1/2] percent plus or minus 1.5 percent for **1-1/2-inch** nominal maximum aggregate size.
 - b. [6] [4-1/2] [3] percent plus or minus 1.5 percent for **1-inch** nominal maximum aggregate size.
 - c. [6] [5] [3-1/2] percent plus or minus 1.5 percent for **3/4-inch** nominal maximum aggregate size.
- E. Limit water-soluble, chloride-ion content in hardened concrete to [0.15] [0.30] percent by weight of cement.
- F. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.
1. Use [water-reducing admixture] [water-reducing and retarding admixture] [water-reducing and accelerating admixture] in concrete as required for placement and workability.
 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
- G. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than [1.0 lb/cu. yd.] <Insert requirement>.
- H. Color Pigment: Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.
- I. Concrete Mixtures: Normal-weight concrete.
1. Compressive Strength (28 Days): [4500 psi] [4000 psi] [3500 psi] [3000 psi] <Insert strength>.
 2. Maximum W/C Ratio at Point of Placement: [0.45] [0.50] <Insert ratio>.
 3. Slump Limit: [4 inches] [5 inches] <Insert dimension>, plus or minus 1 inch.

17.6 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M [and ASTM C1116/C1116M]. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between **85 and 90 deg F**, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above **90 deg F**, reduce mixing and delivery time to 60 minutes.
- B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For concrete batches of **1 cu. yd.** or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches larger than **1 cu. yd.**, increase mixing time by 15 seconds for each additional **1 cu. yd.**
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixing time, quantity, and amount of water added.

PART 18 - EXECUTION

18.1 EXAMINATION

- A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.
- B. Proof-roll prepared subbase surface below [**decorative concrete paving**] <Insert locations> to identify soft pockets and areas of excess yielding.
 1. Completely proof-roll subbase in one direction[**and repeat in perpendicular direction**]. Limit vehicle speed to **3 mph**.
 2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than **15 tons**.
 3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of [**1/2 inch**] <Insert dimension> according to requirements in Section 312000 "Earth Moving."
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

18.2 PREPARATION

- A. Remove loose material from compacted subbase surface immediately before placing concrete.
- B. Protect adjacent construction from discoloration and spillage during application of color hardeners, release agents, stains, curing compounds, and sealers.

18.3 EDGE FORMS AND SCREED CONSTRUCTION

- A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.
- B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

18.4 INSTALLATION OF STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

- B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.
- C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.
- D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.
- E. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum **2-inch** overlap to adjacent mats.

18.5 JOINTS

- A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
 - 1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.
- B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
 - 1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
 - 2. Butt Joints: Use [**bonding agent**] [**epoxy-bonding adhesive**] at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 3. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least **1-1/2 inches** into concrete.
 - 4. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.
 - 1. Locate expansion joints at intervals of [**50 feet**] **<Insert dimension>** unless otherwise indicated.
 - 2. Extend joint fillers full width and depth of joint.
 - 3. Terminate joint filler not less than **1/2 inch** or more than **1 inch** below finished surface if joint sealant is indicated.
 - 4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
 - 5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
 - 6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

- D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness, as follows[, **to match jointing of existing adjacent decorative concrete paving**]:
1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a [**1/4-inch**] [**3/8-inch**] radius. Repeat grooving of contraction joints after applying surface finishes. Eliminate grooving-tool marks on concrete surfaces.
 - a. Tolerance: Ensure that grooved joints are within [**3 inches**] **<Insert dimension>** either way from centers of dowels.
 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut **1/8-inch-** wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
 - a. Tolerance: Ensure that sawed joints are within [**3 inches**] **<Insert dimension>** in both directions from centers of dowels.
 3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.
- E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a [**1/4-inch**] [**3/8-inch**] radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

18.6 CONCRETE PLACEMENT

- A. Before placing concrete, inspect and complete formwork installation[, **steel reinforcement**,] and items to be embedded or cast-in.
- B. Remove snow, ice, or frost from subbase surface[**and steel reinforcement**] before placing concrete. Do not place concrete on frozen surfaces.
- C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
- D. Comply with **ACI 301** requirements for measuring, mixing, transporting, and placing concrete.
- E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.
- F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.
- G. Consolidate concrete according to **ACI 301** by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
 1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal

vibrator. Keep vibrator away from joint assemblies[, **reinforcement**,] or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating [**reinforcement**] [**dowels**] [**and**] joint devices.

- H. Screed paving surface with a straightedge and strike off.
- I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

18.7 FLOAT FINISHING

- A. General: Do not add water to concrete surfaces during finishing operations.
- B. Float Finish: Begin the second floating operation when bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

18.8 INTEGRALLY COLORED CONCRETE FINISH

- A. Integrally Colored Concrete Finish: After final floating, apply the following finish:
 - 1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - 2. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - 3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface **1/16 to 1/8 inch** deep with a stiff-bristled broom, perpendicular to line of traffic.

18.9 STENCILING

- A. Cut stencils to slab width and lay on wet concrete. Overlap "mortar joint" on trailing edge of each section of stencil onto leading "mortar joint" of previous section.
- B. Trim stencils to fit slab and adjacent patterns.
- C. Slightly embed stencil into concrete by rolling with stencil roller.
- D. Apply pigmented mineral dry-shake hardener materials to concrete surfaces according to manufacturer's written instructions.
- E. Stencil Rolling:
 - 1. Apply [**pigmented powder release agent**] [**liquid release agent**] according to manufacturer's written instructions prior to applying texture roller to surface of concrete.
 - 2. Perform rolling operation to produce required texture on concrete surface.

- F. Remove stencils when concrete has sufficiently cured to bear weight. Do not leave stencils in concrete overnight.
- G. Remove debris with mechanical blower prior to application of curing compound. If release agent is applied, delay removal of debris for 24 hours, then flood area with low-pressure water hose, wetting release agent, and follow by cleaning surface with pressure washer.

18.10 PIGMENTED MINERAL DRY-SHAKE HARDENER APPLICATION

- A. Pigmented Mineral Dry-Shake Hardener Finish: After initial floating, apply dry-shake materials to paving surfaces according to manufacturer's written instructions and as follows:
 - 1. Uniformly apply dry-shake hardener at a rate of **[100 lb/100 sq. ft.]** <Insert rate of application> unless greater amount is recommended by manufacturer to match paving color required.
 - 2. Uniformly distribute approximately two-thirds of dry-shake hardener over the concrete surface with mechanical spreader; allow hardener to absorb moisture and embed it by power floating. Follow power floating with a second application of pigmented mineral dry-shake hardener, uniformly distributing remainder of material at right angles to first application to ensure uniform color, and embed hardener by final power floating.
 - 3. After final power floating, apply the following finish:
 - a. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
 - b. Medium-to-Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface, perpendicular to line of traffic, to provide a uniform, fine-line texture.
 - c. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface **1/16 to 1/8 inch** deep with a stiff-bristled broom, perpendicular to line of traffic.
- B. Pigmented Powder Release Agent: Uniformly distribute onto dry-shake-hardened and still-plastic concrete at a rate of **3 to 4 lb/100 sq. ft.**
- C. Liquid Release Agent: Uniformly mist surface of dry-shake-hardened and still-plastic concrete at a rate of **5 gal/1000 sq. ft.**

18.11 STAMPING

- A. Mat Stamping: After floating and while concrete is plastic, apply mat-stamped finish.
 - 1. Pigmented Powder Release Agent: Uniformly distribute onto concrete at a rate of **3 to 4 lb/100 sq. ft.**
 - 2. Liquid Release Agent: Apply liquid release agent to the concrete surface and the stamp mat. Uniformly mist surface of concrete at a rate of **5 gal/1000 sq. ft.**
 - 3. After application of release agent, accurately align and place stamp mats in sequence.
 - 4. Uniformly load mats and press into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp mats. Hand stamp edges and surfaces unable to be imprinted by stamp mats.
 - 5. Remove residual release agent according to manufacturer's written instructions, but no

fewer than three days after stamping concrete. High-pressure-wash surface and joint patterns, taking care not to damage stamped concrete. Control, collect, and legally dispose of runoff.

- B. Tool Stamping: After floating and while concrete is plastic, apply tool-stamped finish.
 - 1. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends **3 inches**, and secure to edge forms. Lightly broom surface to remove air bubbles.
 - 2. Accurately align and place stamp tools in sequence and tamp into concrete to produce required imprint pattern and depth of imprint on concrete surface. Gently remove stamp tools. Hand stamp edges and surfaces unable to be imprinted by stamp tools.
 - 3. Carefully remove polyethylene film immediately after tool stamping.
- C. Roller Stamping: After floating and while concrete is plastic, apply roller-stamped finish.
 - 1. Cover surface with polyethylene film, stretch taut to remove wrinkles, lap sides and ends **3 inches**, and secure to edge forms. Lightly broom surface to remove air bubbles.
 - 2. Accurately align roller and perform rolling operation to produce required imprint pattern and depth of imprint on concrete surface. Hand stamp surfaces inaccessible to roller.
 - 3. Carefully remove polyethylene film immediately after roller stamping.

18.12 CONCRETE PROTECTION AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.
 - B. Comply with ACI 306.1 for cold-weather protection.
 - C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching **0.2 lb/sq. ft. x h** before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete but before float finishing.
 - D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.
 - E. Curing Compound: Apply immediately after final finishing. Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.
 - 1. Cure integrally colored concrete with a[**pigmented**] curing compound.
 - 2. Cure concrete finished with pigmented mineral dry-shake hardener with a[**pigmented**] curing compound.
 - F. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating, and repair damage during curing period.
 - G. Curing Paper: Cure with unwrinkled curing paper in pieces large enough to cover the entire width and edges of slab. Do not lap sheets. Fold curing paper down over paving edges and secure with
- LED EXTERIOR LIGHTING

continuous banks of earth to prevent displacement or billowing due to wind. Immediately repair holes or tears in paper.

18.13 STAINING

- A. Newly placed concrete paving shall be at least **[14] [30] <Insert number>** days old before staining.
- B. Prepare surfaces according to manufacturer's written instructions and as follows:
 - 1. Clean concrete thoroughly by scraping, applying solvents or stripping agents, sweeping and pressure washing, or scrubbing with a rotary floor machine and detergents recommended by stain manufacturer. Rinse until water is clear and allow surface to dry.
 - a. Do not use acidic solutions to clean surfaces.
 - 2. Test surfaces with droplets of water. If water beads and does not penetrate surface, or penetrates only in some areas, profile surfaces by **[acid etching] [grinding, sanding, or abrasive blasting]**. Retest and continue profiling surface until water droplets immediately darken and uniformly penetrate concrete surfaces.
 - 3. Apply acidic solution to dampened concrete surfaces, scrubbing with uncolored, acid-resistant nylon-bristle brushes until bubbling stops and concrete surface has texture of 120-grit sandpaper. Do not allow solution to dry on concrete surfaces. Rinse until water is clear. Control, collect, and legally dispose of runoff.
 - 4. Neutralize concrete surfaces and rinse until water is clear. Test surface for residue with clean white cloth. Test surface according to ASTM F710 to ensure pH is between **[7 and 8] <Insert values>**.
- C. Scoring: Score decorative jointing in paving surfaces **1/16 inch** deep with diamond blades to match pattern indicated. Rinse until water is clear. Score **[after] [before]** staining.
 - 1. Joint Width: **[3/8 inch] <Insert dimension>**.
- D. Allow paving surface to dry before applying stain. Verify readiness of paving to receive stain according to ASTM D4263 by tightly taping **18-by-18-inch, 4-mil-** thick polyethylene sheet to a representative area of paving surface. Apply stain only if no evidence of moisture has accumulated under sheet after 16 hours.
- E. Reactive Stain: Apply reactive stain to paving surfaces according to manufacturer's written instructions and as follows:
 - 1. Apply stain by uncolored bristle brush, roller, or high-volume, low-pressure sprayer and immediately scrub into concrete surface with uncolored, acid-resistant nylon-bristle brushes in continuous, circular motion. Do not spread stain after fizzing stops. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
 - 2. Remove stain residue after four hours by wet scrubbing with commercial-grade detergent recommended by stain manufacturer. Rinse until water is clear. Control, collect, and legally dispose of runoff.
- F. Penetrating Stain: Apply to paving surfaces according to manufacturer's written instructions and as follows:

1. Apply first coat of stain to dry, clean surfaces by airless sprayer or by high-volume, low-pressure sprayer.
2. Allow to dry four hours and repeat application of stain in sufficient quantity to obtain color consistent with approved mockup.
3. Rinse until water is clear. Control, collect, and legally dispose of runoff.

18.14 SEALER APPLICATION

- A. Clear Acrylic Sealer: Apply uniformly in two coats in continuous operations according to manufacturer's written instructions. Allow first coat to dry before applying second coat, at 90 degrees to the direction of the first coat, using same application methods and rates.
1. Begin sealing dry surface no sooner than [14] <Insert number> days after concrete placement.
 2. Allow stained concrete surfaces to dry before applying sealer.
 3. Thoroughly mix slip-resistance-enhancing additive into sealer before applying sealer according to manufacturer's written instructions. Stir sealer occasionally during application to maintain even distribution of additive.

18.15 PAVING TOLERANCES

- A. Comply with tolerances in **ACI 117** and as follows:
1. Elevation: **3/4 inch.**
 2. Thickness: Plus **3/8 inch**, minus **1/4 inch.**
 3. Surface: Gap below **10-foot-** long, unleveled straightedge not to exceed **1/2 inch.**
 4. Lateral Alignment and Spacing of Dowels: **1 inch.**
 5. Vertical Alignment of Dowels: **1/4 inch.**
 6. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: **1/4 inch per 12 inches** of dowel.
 7. Joint Spacing: **3 inches.**
 8. Contraction Joint Depth: Plus **1/4 inch**, no minus.
 9. Joint Width: Plus **1/8 inch**, no minus.

18.16 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Testing Services: Testing of composite samples of fresh concrete obtained according to ASTM C172/C172M shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each [**100 cu. yd.**] [**5000 sq. ft.**] or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143/C143M; one test at point of placement for each composite sample, but

not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is **40 deg F** and below and when it is **80 deg F** and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.
- C. Strength of each concrete mixture will be satisfactory if 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**.
- D. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
- F. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
- G. Decorative concrete paving will be considered defective if it does not pass tests and inspections.
- H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
- I. Prepare test and inspection reports.

18.17 REPAIR AND PROTECTION

- A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.
- B. Detailing: Grind concrete "squeeze" left from tool placement. Color ground areas with slurry of color hardener mixed with water and bonding agent. Remove excess release agent with high-velocity blower.
- C. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

- D. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

18.18 DECORATIVE CONCRETE PAVING SCHEDULE

- A. Patterned Decorative Concrete Paving <Insert drawing designation>:
1. Locations: Install at [drives] [parking lots] [walks] [patios] [and] [swimming pool decks] <Insert location>.
 2. Coloring Method: [Integrally colored] [Pigmented mineral dry-shake hardener].
 - a. Color: [As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.
 3. Field Patterning Method: [Stamped] [Stenciled].
 - a. Texture and Pattern: [Keystone installed at 45-degrees diagonal to main lines of building] <Insert requirement>.
 - b. Pigmented Mineral Dry-Shake Hardener: <Insert color>.
 - c. Release Agent: [Match pigmented mineral dry-shake hardener] <Insert color>.
 4. Border and Accent Strip Patterning Method: [Stamped] [Stenciled].
 - a. Texture and Pattern: <Insert requirement>.
 - b. Pigmented Mineral Dry-Shake Hardener: <Insert color>.
 - c. Release Agent: [Match pigmented mineral dry-shake hardener] <Insert color>.
- B. Stained Decorative Concrete Paving <Insert drawing designation>:
1. Locations: Install at [drives] [parking lots] [walks] [patios] [and] [swimming pool decks] <Insert location>.
 2. Staining Method: [Reactive] [Penetrating] stain.
 3. Color: [As indicated by manufacturer's designation] [Match Architect's sample] [As selected by Architect from manufacturer's full range] <Insert color>.

END OF SECTION 321316

SECTION 321373 - CONCRETE PAVING JOINT SEALANTS

PART 19 - GENERAL

19.1 SUMMARY

- A. Section Includes:
1. Joint-sealant backer materials.
 2. Primers.

19.2 PREINSTALLATION MEETINGS

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

19.3 ACTION SUBMITTALS

- A. Product Data:
1. Concrete pavement joint sealants.
 2. Joint-sealant backer materials.
- B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.
- C. Samples for Verification: Actual sample of finished products for each kind and color of joint sealant required.
1. Size: Joint sealants in **1/2-inch-** wide joints formed between two **6-inch-** long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Paving-Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

19.4 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For **[Installer]** **[testing agency]**.

19.5 QUALITY ASSURANCE

- A. Qualifications:
1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

19.6 PRECONSTRUCTION TESTING

- A. Preconstruction Testing: Performed by a qualified testing agency.

19.7 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer[or are below **40 deg F**].

2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 20 - PRODUCTS

20.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer[**for each sealant type**].

20.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

20.3 JOINT-SEALANT BACKER MATERIALS

- A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.
- B. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- D. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

20.4 PRIMERS

- A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 21 - EXECUTION

21.1 EXAMINATION

- A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant

performance.

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

21.2 PREPARATION

- A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.
 - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
- B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

21.3 INSTALLATION OF JOINT SEALANTS

- A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.
- C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
 - 1. Do not leave gaps between ends of joint-sealant backer materials.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
 - 3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.
- D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:
 - 1. Place joint sealants so they fully contact joint substrates.
 - 2. Completely fill recesses in each joint configuration.
 - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:
 - 1. Remove excess joint sealant from surfaces adjacent to joints.
 - 2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

- F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

21.4 CLEANING AND PROTECTION

- A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.
- B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

21.5 PAVING-JOINT-SEALANT SCHEDULE

- A. Joints within concrete paving[**PJS-#**]:
 - 1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: [**Single-component, nonsag, silicone joint sealant**] [**Single-component, self-leveling, silicone joint sealant**] [**Multicomponent, nonsag, urethane, elastomeric joint sealant**] [**Single component, pourable, urethane, elastomeric joint sealant**] [**Multicomponent, pourable, urethane, elastomeric joint sealant**] [**Hot-applied, single-component joint sealant**] <Insert joint sealant>.
 - 3. Joint-Sealant Color: [**Manufacturer's standard**] <Insert color>.
- B. Joints within concrete paving and between concrete and asphalt paving[**PJS-#**]:
 - 1. Joint Location:
 - a. Joints between concrete and asphalt paving.
 - b. Joints between concrete curbs and asphalt paving.
 - c. Other joints as indicated.
 - 2. Joint Sealant: [**Hot-applied, single-component joint sealant**] <Insert joint sealant>.
 - 3. Joint-Sealant Color: [**Manufacturer's standard**] <Insert color>.
- C. Fuel-resistant joints within concrete paving[**PJS-#**]:
 - 1. Joint Location:
 - a. Expansion and isolation joints in concrete paving.
 - b. Contraction joints in concrete paving.
 - c. Other joints as indicated.

2. Joint Sealant: [Fuel-resistant, single-component, pourable, modified-urethane, elastomeric joint sealant] [Fuel-resistant, multicomponent, pourable, modified-urethane, elastomeric joint sealant] [Hot-applied, fuel-resistant, single-component joint sealant] <Insert joint sealant>.
3. Joint-Sealant Color: [Manufacturer's standard] <Insert color>.

END OF SECTION 321373

SECTION 321400 - UNIT PAVING

PART 22 - GENERAL

22.1 SUMMARY

A. Section Includes:

1. Brick pavers.
2. Concrete pavers.

22.2 PREINSTALLATION MEETINGS

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

22.3 ACTION SUBMITTALS

A. Product Data:

1. For materials other than water and aggregates.
2. For the following:
 - a. Pavers.
 - b. Bituminous setting materials.
 - c. Mortar and grout materials.
 - d. Edge restraints.
 - e. Precast concrete curbs.
 - f. Granite curbs.

B. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Environmental Product Declaration (EPD): For each product.
3. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
4. Environmental Product Declaration: For each product.
5. Product Certificates: For regional materials, indicating location of material manufacturer

- and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
- 6. Environmental Product Declaration: For each product.
- 7. Environmental Product Declaration: For each product.
- 8. Third-Party Certifications: For each product.
- 9. Third-Party Certified Life Cycle Assessment: For each product.
- C. Sieve Analyses: For aggregate setting-bed materials, according to ASTM C136.
- D. 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.
- E. 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.

22.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Adhesion and Compatibility Test Reports: From latex-additive manufacturer for mortar and grout containing latex additives.
- C. 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.
- D. 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 C67.

22.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified unit paving installer. Installer's [**field supervisor**] [**personnel assigned to the Work**] must have Concrete Paver Installer Certification from the Interlocking Concrete Pavement Institute (ICPI) with [**one of**] [**both of**] the following designations:
 - 1. Residential Paver Technician Designation.
 - 2. Commercial Paver Technician Designation.

- B. 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.

22.6 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.

22.7 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.

22.8 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** and when base is dry.
 - 2. Apply asphalt adhesive only when ambient temperature is above **50 deg F** and when temperature has not been below **35 deg F** 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** and higher.

- a. When ambient temperature exceeds **100 deg F**, or when wind velocity exceeds **8 mph** and ambient temperature exceeds **90 deg F**, set pavers within 1 minute of spreading setting-bed mortar.

PART 23 - PRODUCTS

23.1 SOURCE LIMITATIONS

- A. 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.

23.2 BRICK PAVERS

- A. Regional Materials: Brick shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.
- B. Regional Materials: Brick shall be manufactured within **500 miles** of Project site.
- C. Regional Materials: Brick shall be manufactured within **100 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **100 miles** of Project site.
- D. Indigenous Materials: Brick shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- E. Regional Materials: Brick shall be manufactured within **500 miles** of Project site from materials that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- F. Brick Pavers, Light-Traffic Paving Brick: ASTM C902, 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**] [**1-1/2 inches**] [**1-5/8 inches**] [**2-1/4 inches**] [**2-5/8 inches**] [As indicated] <Insert dimension>.
 2. Face Size: [**3-3/4 by 7-1/2 inches**] [**3-5/8 by 7-5/8 inches**] [**3-5/8 by 11-5/8 inches**] [**7-5/8 by 7-5/8 inches**] [**4 by 8 inches**] [**4 by 12 inches**] [**8 by 8 inches**] [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>.

- G. Brick Pavers, Heavy Vehicular Paving Brick: ASTM C1272, [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] [2-5/8 inches] [As indicated] <Insert dimension>.
 2. Face Size: [3-3/4 by 7-1/2 inches] [3-5/8 by 7-5/8 inches] [3-5/8 by 11-5/8 inches] [7-5/8 by 7-5/8 inches] [4 by 8 inches] [4 by 12 inches] [8 by 8 inches] [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>.
- H. Efflorescence: Brick to be rated "not effloresced" when tested according to ASTM C67.
- I. 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.

23.3 CONCRETE PAVERS

- A. Regional Materials: Concrete pavers shall be manufactured within **500 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site.
- B. Regional Materials: Concrete pavers shall be manufactured within **500 miles** of Project site.
- C. Regional Materials: Concrete pavers shall be manufactured within **100 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **100 miles** of Project site.
- D. Indigenous Materials: Concrete pavers shall be manufactured within **500 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- E. Regional Materials: Concrete pavers shall be manufactured within **500 miles** of Project site from aggregates[**and cementitious materials**] that have been extracted, harvested, or recovered, as well as manufactured, within **500 miles** of Project site. If materials are transported by rail or water, the distance transported by rail or water shall be multiplied by 0.25 to determine the distance to Project site.
- F. Concrete Pavers, Solid Interlocking Paving Units: Complying with ASTM C936/C936M[**and resistant to freezing and thawing when tested according to ASTM C67**], made from normal-weight aggregates.

1. Thickness: **[2-3/8 inches]** **[3-1/8 inches]** **<Insert dimension>**.
 2. Face Size and Shape:
 - a. **[3-7/8 inches]** **[4-7/16 inches]** **[8-7/8 inches]** **[9 inches]** square.
 - b. **[3-7/8-by-7-7/8-inch]** **[4-by-8-inch]** **[4-7/16-by-8-7/8-inch]** rectangle.
 - c. **[5-1/2-inch octagon with attached 3-1/2-inch square]** **[4-1/2-by-9-inch rectangle with saw-tooth edges]** **[4-3/4-inch rectangular and trapezoidal units arranged in semicircular courses to produce fan-shaped pattern]** **[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>**.
- G. Concrete Pavers, Solid Paving Units, Normal-Weight Concrete: Solid paving units made from normal-weight concrete with a compressive strength not less than **[5000 psi]** **[6000 psi]** **<Insert value>**, water absorption not more than 5 percent according to ASTM C140, and no breakage and not more than 1 percent mass loss when tested for freeze-thaw resistance according to ASTM C67.
1. Thickness: **[1-5/8 inches]** **[1-3/4 inches]** **[2 inches]** **[2-3/8 inches]** **<Insert dimension>**.
 2. Face Size and Shape:
 - a. **[8-7/8 inches]** **[9 inches]** **[12 inches]** **[18 inches]** **[24 inches]** square.
 - b. **[9-by-18-inch]** **[12-by-24-inch]** rectangle.
 - c. **[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>**.
- H. Concrete Pavers, Solid Paving Units, Lightweight Concrete: Solid paving units complying with ASTM C1491, made from lightweight concrete.
1. Thickness: **[1-5/8 inches]** **[1-3/4 inches]** **[2 inches]** **<Insert dimension>**.
 2. Face Size and Shape: **[9 inches square]** **[12 inches square]** **[18 inches 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>**.
- 23.4 ACCESSORIES
- A. Cork Joint Filler: Preformed strips complying with ASTM D1752, Type II.
 - B. Compressible Foam Filler: Preformed strips complying with ASTM D1056, Grade 2A1.
- 23.5 AGGREGATE SETTING-BED MATERIALS
- A. Graded Aggregate for Subbase: Sound, crushed stone or gravel complying with **[ASTM D448 for Size No. 57]** **[ASTM D2940/D2940M, subbase material]** **[requirements in Section 312000 "Earth Moving" for subbase material]**.
 - B. Graded Aggregate for Base: Sound, crushed stone or gravel complying with **[ASTM D448 for**

Size No. 8] [ASTM D2940/D2940M, 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 C33/C33M for fine aggregate.
- D. Stone Screenings for Leveling Course: Sound stone screenings complying with ASTM D448 for Size No. 10.
- E. Sand for Joints: Fine, sharp, washed, natural sand or crushed stone with 100 percent passing **No. 16** sieve and no more than 10 percent passing **No. 200** 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** sieve, maximum; ASTM D4751.
 - 3. Permittivity: 0.02 per second, minimum; ASTM D4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.
- 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** sieve, maximum; ASTM D4751.
 - 3. Permittivity: 0.5 per second, minimum; ASTM D4491.
 - 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D4355.
- H. Herbicide: Commercial chemical for weed control, registered with the EPA. Provide in granular, liquid, or wettable powder form.

23.6 BITUMINOUS SETTING-BED MATERIALS

- A. Primer for Base: ASTM D2028/D2028M, cutback asphalt, grade as recommended by unit paver manufacturer.
- B. Fine Aggregate for Setting Bed: ASTM D1073, No. 2 or No. 3.
- C. Asphalt Cement: ASTM D3381/D3381M, 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** sieve and no more than 10 percent passing **No. 200** sieve.

1. Provide sand of color needed to produce required joint color.

23.7 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**.

23.8 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 C270, 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 24 - EXECUTION

24.1 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**].

24.2 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.

24.3 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:

1. Do not exceed **1/32-inch** unit-to-unit offset from flush (lippage) or **1/8 inch in 10 feet** from level, or indicated slope, for finished surface of paving.
 2. Do not exceed[**1/16-inch unit-to-unit offset from flush (lippage) nor 1/8 inch in 24 inches and] 1/4 inch in 10 feet** from level, or indicated slope, for finished surface of paving.
- H. Expansion and Control Joints:
1. 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."
 2. 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.
- I. 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** 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.
- J. 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.
- 24.4 AGGREGATE SETTING-BED APPLICATIONS
- A. Compact soil subgrade uniformly to at least [95] **<Insert number>** percent of [ASTM D698] [ASTM D1557] 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**.
- 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 D1557 maximum laboratory density, and screed to depth indicated.
- F. Place drainage geotextile over compacted base course, overlapping ends and edges at least **12 inches**.
- G. Place leveling course and screed to a thickness of **1 to 1-1/2 inches**, 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** and a maximum of **1/8 inch**, 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**] <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** 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** of uncompacted pavers adjacent to temporary edges.
 - 2. Before ending each day's work, compact installed concrete pavers except for **36-inch** 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** 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.

24.5 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-** deep control bars approximately **11 feet** 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**. Strike setting bed smooth, firm, even, and not less than **3/4 inch** 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**. 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**.
- D. Apply neoprene-modified asphalt adhesive to cold setting bed by squeegeeing or troweling to a uniform thickness of **1/16 inch**. 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.

24.6 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** 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**.
- 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.** per minute when tested according to ASTM C67. 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**- 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**] [**1/2-inch**] [**3/4-inch**] nominal joint width with variations not exceeding plus or minus [**1/16 inch**] [**1/8 inch**] [**3/16 inch**].
- 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.

24.7 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 323223 - SEGMENTAL RETAINING WALLS

PART 25 - GENERAL

25.1 SUMMARY

A. Section Includes:

1. Segmental retaining walls.

B. Related Requirements:

1. Section 312000 "Earth Moving" for excavation for segmental retaining walls, base material, soil fill, fill placement and compaction, and field in-place density testing.

25.2 PREINSTALLATION MEETINGS

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

25.3 ACTION SUBMITTALS

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

B. Shop Drawings:

1. Show sizes, profiles, coursing, and locations of retaining wall units; including backfill and leveling base materials.
2. Show types, sizes, locations of soil reinforcing materials.
3. <Insert requirements>.
4. Signed and sealed by the qualified professional engineer responsible for their preparation.

- C. Samples for Initial Selection:** Manufacturer's standard color sheets, showing full range of available colors and textures for segmental retaining wall units.

- D. Samples for Verification:** Actual sample of finished products for each type of exposed finish of segmental retaining wall units.

1. Size: **[Manufacturers' standard size]** **[full-size units]** [sections of units not less than **3 inches square**] <Insert size>.

- E. Delegated Design Submittals:** For segmental retaining walls, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Sustainable Design Submittals:

1. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Environmental Product Declaration (EPD): For each product.

3. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
4. Environmental Product Declaration: For each product.
5. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
6. Environmental Product Declaration: For each product.
7. Environmental Product Declaration: For each product.
8. Third-Party Certifications: For each product.
9. Third-Party Certified Life Cycle Assessment: For each product.

25.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Product Certificates: For each type of segmental retaining wall unit[**and soil reinforcement**] from manufacturer.
 1. Include test data for shear strength between segmental retaining wall units in accordance with ASTM D6916.
 2. Include test data for connection strength between segmental retaining wall units and soil reinforcement in accordance with ASTM D6638.
- C. Test and Evaluation Reports:
 1. Product Test Reports: For each type of segmental retaining wall unit[**and soil reinforcement**], for tests performed by [**qualified testing agency**] [**manufacturer and witnessed by a qualified testing agency**].
 - a. Include test data for shear strength between segmental retaining wall units in accordance with ASTM D6916.
 - b. Include test data for connection strength between segmental retaining wall units and soil reinforcement in accordance with ASTM D6638.
 2. Research Reports: For segmental retaining wall system, from [**an agency acceptable to authorities having jurisdiction**] [**ICC-ES**] < **Insert evaluation agency** > showing compliance with [**building code requirements**] < **Insert requirement** >.
 3. Preconstruction Test Reports: For segmental retaining wall units[**and soil reinforcement**].
- D. Source Quality-Control Submittals:
 1. Source quality-control reports.
- E. Field Quality-Control Submittals:
 1. Field quality-control reports.
- F. Qualification Statements: For [**testing agency**] < **Insert entity or specialist** >.
- G. Delegated design engineer qualifications.

25.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers certified under the National Concrete Masonry Association (NCMA) Certified Segmental Retaining Wall Installer program at the **[Basic]** **[Advanced Commercial]** certification level.
2. Delegated Design Engineer: A professional engineer who is legally qualified to practice in **[state]** **<Insert jurisdiction>** where Project is located and who is experienced in providing engineering services of the type indicated.
3. Testing Agency: Qualified in accordance with ASTM E329 for testing indicated.

25.6 MOCKUPS

A. Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects.

1. Build mockup of segmental retaining wall **[as indicated on Drawings]** [approximately **72 inches long by not less than 36 inches high above finished grade at front of wall**].
 - a. Include typical soil reinforcement.
 - b. Include typical base and cap or finished top construction.
 - c. Include backfill to typical finished grades at both sides of wall.
 - d. Include typical end construction at one end of mockup.
 - e. Include **36-inch** return at one end of mockup, with typical corner construction.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

25.7 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform the following preconstruction testing:

1. Test soil reinforcement and backfill materials for pullout resistance in accordance with ASTM D6706.
2. Test soil reinforcement and backfill materials for coefficient of friction in accordance with ASTM D5321/D5321M.

25.8 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle concrete units and accessories to prevent deterioration or damage due to contaminants, breaking, chipping, or other causes.
- B. Store geosynthetics in manufacturer's original packaging with labels intact. Store and handle geosynthetics to prevent deterioration or damage due to sunlight, chemicals, flames, temperatures above **160 deg F** or below **32 deg F**, and other conditions that might damage them. Verify identification of geosynthetics before use, and examine them for defects as material is placed.

PART 26 - PRODUCTS

26.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design segmental retaining walls.
- B. Compliance Review: Qualified professional engineer responsible for segmental retaining wall design shall review and approve submittals and source and field quality-control reports for compliance of materials and construction with design.
- C. Structural Performance: Engineering design shall be based on the following loads and be in accordance with [NCMA's "Design Manual for Segmental Retaining Walls."] **<Insert applicable requirement.>**
 - 1. Gravity loads due to soil pressures resulting from grades[**and sloped backfill**] indicated.
 - 2. Superimposed loads (surcharge) indicated on Drawings.
 - 3. Horizontal Peak Ground Acceleration (A) for Project: **<Insert value>**.

26.2 SOURCE QUALITY CONTROL

- A. Factory test and inspect each roll of soil reinforcement for minimum average roll values for geosynthetic index property tests, including the following:
 - 1. Weight.
 - 2. Grab or single-rib strength.
 - 3. Aperture opening.
 - 4. Rib or yarn size.

PART 27 - EXECUTION

27.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for excavation tolerances, condition of subgrades, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

27.2 INSTALLATION OF RETAINING WALLS

- A. General: Place units in accordance with NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
 - 1. Lay units in [running bond] [bond pattern indicated].
 - 2. Form corners and ends by [using special units] [cutting units with motor-driven saw] [or] [splitting units with mason's hammer and chisel].

- B. Do not use units with chips, cracks, or other defects that are visible at a distance of **20 feet** where such defects are exposed in the completed Work.
- C. Leveling Base: Place and compact base material to thickness indicated and with not less than 95 percent maximum dry unit weight in accordance with ASTM D698.
 - 1. Leveling Course: [At Contractor's option, unreinforced lean concrete may be substituted for upper **1 to 2 inches of base**] [Place unreinforced lean concrete over leveling base **1 to 2 inches thick**]. Compact and screed concrete to a smooth, level surface.
- D. First Course: Place first course of segmental retaining wall units for full length of wall. Place units in firm contact with each other, properly aligned and level.
 - 1. Tamp units into leveling base as necessary to bring tops of units into a level plane.
- E. Subsequent Courses: Remove excess fill and debris from tops of units in course below. Place units in firm contact, properly aligned, and directly on course below.
 - 1. For units with lugs designed to fit into holes in adjacent units, lay units so lugs are accurately aligned with holes, and bedding surfaces are firmly seated on beds of units below.
 - 2. For units with lips at front of units, slide units as far forward as possible for firm contact with lips of units below.
 - 3. For units with lips at bottom rear of units, slide units as far forward as possible for firm contact of lips with units below.
 - 4. For units with pins, install pins and align units.
 - 5. For units with clips, install clips and align units.
- F. Cap Units: Place cap units and secure with cap adhesive.

27.3 FILL PLACEMENT

- A. General: Comply with requirements in Section 312000 "Earth Moving," with NCMA's "Segmental Retaining Wall Installation Guide" and segmental retaining wall unit manufacturer's written instructions.
- B. Fill voids between and within units with drainage fill. Place fill as each course of units is laid.
- C. Place, spread, and compact drainage fill and soil fill in uniform lifts for full width and length of embankment as wall is laid. Place and compact fills without disturbing alignment of units. Where both sides of wall are indicated to be filled, place fills on both sides at same time. Begin at wall, and place and spread fills toward embankment.
 - 1. Use only hand-operated compaction equipment within **48 inches** of wall or one-half of height above bottom of wall, whichever is greater.
 - 2. Compact reinforced-soil fill to not less than 95 percent maximum dry unit weight in accordance with ASTM D698.
 - a. In areas where only hand-operated compaction equipment is allowed, compact fills to not less than 90 percent maximum dry unit weight in accordance with ASTM D698.
 - b. In areas where fill height exceeds **15 feet** compact reinforced-soil fill that will be more than **15 feet** below finished grade to not less than 98 percent maximum dry unit

- weight in accordance with ASTM D698.
- c. In areas where fill height exceeds **30 feet** compact reinforced-soil fill that will be more than **30 feet** below finished grade to not less than 100 percent maximum dry unit weight in accordance with ASTM D698.
3. Compact nonreinforced-soil fill to comply with Section 312000 "Earth Moving."
- D. Place drainage geotextile against back of wall, and place layer of drainage fill at least [**12 inches**] [**6 inches**] wide behind drainage geotextile to within **12 inches** of finished grade. Place another layer of drainage geotextile between drainage fill and soil fill.
 - E. Place a layer of drainage fill at least [**12 inches**] [**6 inches**] wide behind wall to within **12 inches** of finished grade. Place a layer of drainage geotextile between drainage fill and soil fill.
 - F. Wrap subdrainage pipe with filter fabric and place in drainage fill as indicated[, **sloped not less than 0.5 percent to drain**].
 - G. Place impervious fill over top edge of drainage fill layer.
 - H. Slope grade at top of wall away from wall unless otherwise indicated. Slope grade at wall base away from wall. Provide uniform slopes that prevent ponding.
 - I. Place soil reinforcement in horizontal joints of retaining wall where indicated and in accordance with soil-reinforcement manufacturer's written instructions. Embed reinforcement a minimum of **8 inches** into retaining wall and stretch tight over compacted backfill. Anchor soil reinforcement before placing fill.
 - 1. Place additional soil reinforcement at corners and curved walls to provide continuous reinforcement.
 - 2. Place geosynthetics with seams, if any, oriented perpendicularly to segmental retaining walls.
 - 3. Do not dump fill material directly from trucks onto geosynthetics.
 - 4. Place at least **6 inches** of fill over reinforcement before compacting with tracked vehicles or **4 inches** before compacting with rubber-tired vehicles.
 - 5. Do not turn vehicles on fill until first layer of fill is compacted and second layer is placed over each soil-reinforcement layer.
- 27.4 CONSTRUCTION TOLERANCES
- A. Variation from Level: For bed-joint lines along walls, do not exceed **1-1/4 inches in 10 feet, 3 inches** maximum.
 - B. Variation from Indicated Batter: For slope of wall face, do not vary from indicated slope by more than **1-1/4 inches in 10 feet**.
 - C. Variation from Indicated Wall Line: For walls indicated as straight, do not vary from straight line by more than **1-1/4 inches in 10 feet**.
 - D. Maximum Gap between Units: **1/8 inch**.

27.5 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Comply with requirements in Section 312000 "Earth Moving" for field quality control.
- C. Tests and Inspections:
 - 1. In each compacted backfill layer, perform at least one field in-place compaction test for each [**150 feet**] <Insert dimension> or less of segmental retaining wall length.
 - 2. In each compacted backfill layer, perform at least one field in-place compaction test for each [**24 inches**] <Insert dimension> of fill depth and each [**50 feet**] <Insert dimension> or less of segmental retaining wall length.
 - 3. Segmental retaining wall system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

27.6 ADJUSTING

- A. Remove and replace segmental retaining wall construction of the following descriptions:
 - 1. Broken, chipped, stained, or otherwise damaged units. Units may be repaired if Architect approves methods and results.
 - 2. Segmental retaining walls that do not match approved Samples[**and mockups**].
 - 3. Segmental retaining walls that do not comply with other requirements indicated.
- B. Replace units so segmental retaining wall matches approved Samples and mockups, complies with other requirements, and shows no evidence of replacement.

END OF SECTION 323223

SECTION 323300 - SITE FURNISHINGS

PART 28 - GENERAL

28.1 SUMMARY

- A. Section Includes:

28.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:

1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
 2. Chain-of-Custody Certificates: For certified wood products. Include statement of costs.
- 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**- long linear components and **4-inch**- 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**].

28.3 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.**]

28.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For site furnishings to include in maintenance manuals.

28.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. 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 29 - PRODUCTS

29.1 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 B211**.
 2. Extruded Bars, Rods, Wire, Profiles, and Tubes: **ASTM B221**.

3. Structural Pipe and Tube: ASTM B429/B429M.
 4. Sheet and Plate: **ASTM B209**.
 5. Castings: ASTM B26/B26M.
- B. Steel and Iron: Free of surface blemishes and complying with the following:
1. Plates, Shapes, and Bars: ASTM A36/A36M.
 2. Steel Pipe: Standard-weight steel pipe complying with ASTM A53/A53M, or electric-resistance-welded pipe complying with ASTM A135/A135M.
 3. Tubing: Cold-formed steel tubing complying with ASTM A500/A500M.
 4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A513/A513M, or steel tubing fabricated from steel complying with ASTM A1011/A1011M and complying with dimensional tolerances in ASTM A500/A500M; zinc coated internally and externally.
 5. Sheet: Commercial steel sheet complying with ASTM A1011/A1011M.
 6. Perforated Metal: From steel sheet not less than **[0.075-inch]** **[0.090-inch]** **[0.120-inch]** **<Insert dimension>** nominal thickness; manufacturer's standard perforation pattern.
 7. Expanded Metal: Carbon-steel sheets, deburred after expansion, and complying with ASTM F1267.
 8. Malleable-Iron Castings: ASTM A47/A47M, grade as recommended by fabricator for type of use intended.
 9. Gray-Iron Castings: ASTM A48/A48M, Class 200.
- C. Stainless Steel: Free of surface blemishes and complying with the following:
1. Sheet, Strip, Plate, and Flat Bars: ASTM A240/A240M or ASTM A666.
 2. Pipe: Schedule 40 steel pipe complying with ASTM A312/A312M.
 3. Tubing: ASTM A554.
- 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. Certified Wood: Wood products shall be certified as "FSC Pure"[or **"FSC Mixed Credit"**] according to FSC STD-01-00 and FSC STD-40-004.
- F. Certified Wood: Wood products shall be certified as "FSC Pure"[or **"FSC Mixed Credit"**] according to FSC STD-01-001 and FSC STD-40-004.
- G. Certified Wood: Wood products shall be labeled according to the AFPA's Sustainable Forestry Initiative, be certified as "FSC Pure" according to FSC STD-01-001 and FSC STD-40-004, or be certified and labeled according to the standards of the Programme for Endorsement of Forest Certification.

- H. Certified Wood: Wood products shall [**contain not less than 60 percent**] [**be made from**] certified wood tracked through a chain-of-custody process. Certified wood documentation shall be provided by sources certified through a forest certification system with principles, criteria, and standards developed using ISO/IEC Guide 59 or the World Trade Organization's "Technical Barriers to Trade."
- I. Certified Wood: Wood products shall be certified according to the American Tree Farm System's "AFF Standard," the AFPA's Sustainable Forestry Initiative, FSC STD-01-001 and FSC STD-40-004, or the standards of the Programme for Endorsement of Forest Certification.
1. Finish: Manufacturer's standard [**stain**] [**and**] [**transparent sealer**] [**transparent wood-preservative treatment and sealer**] <Insert treatment or finish>.
- J. 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.
- K. Plastic: Color impregnated, color and UV-light stabilized, and mold resistant.
1. Polyethylene: Fabricated from virgin plastic HDPE resin.
 2. Polyethylene with Recycled Content: Fabricated from HDPE and other resins with postconsumer recycled content plus one-half of preconsumer recycled content not less than <Insert number> percent.
- L. 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>.
- M. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M; recommended in writing by manufacturer, for exterior applications.
- N. 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.
- O. 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.** 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** thick.
 2. Hot-Dip Galvanizing: According to ASTM A123/A123M, ASTM A153/A153M, or

ASTM A924/A924M.

29.2 WOOD-PRESERVATIVE-TREATED MATERIALS

- A. Preservative Treatment: Pressure-treat wood according to AWP A 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.

29.3 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 AWP A 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.

29.4 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.

29.5 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.

29.6 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.

29.7 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.

29.8 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: ASTM A480/A480M, No 4.
 - 3. Dull Satin Finish: ASTM A480/A480M, No. 6.

PART 30 - EXECUTION

30.1 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.

30.2 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** 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

PART 31 - GENERAL

31.1 SUMMARY

- A. Section Includes:
 - 1. Pipes, tubes, and fittings.
 - 2. Encasement for piping.
 - 3. Automatic drain valves.
 - 4. Miscellaneous piping specialties.

31.2 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.

31.3 ACTION SUBMITTALS

A. Product Data:

1. Pipes, tubes, and fittings.
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.
15. 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. Product Data: For irrigation control system.
2. Product Data: For irrigation submetering.
3. Irrigation Submetering: Provide manufacturer cut sheets for irrigation metering equipment.

31.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Irrigation systems, drawn to scale, on which components are indicated 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. Zoning Chart: Indicate each irrigation zone and its control valve.

C. Controller Timing Schedule: Indicate timing settings for each automatic controller zone.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

- E. Qualification Statements: For **[Installer]** **<Insert entity or specialist>**.
- F. Delegated design engineer qualifications.

31.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For **[sprinklers]** **[controllers]** **[and]** **[automatic control valves]** to include in operation and maintenance manuals.

31.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials to Owner 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 ft.] [500 ft.] <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 ft.] [100 ft.] <Insert value>**.
- B. Schedule of maintenance material items.

31.7 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Installers: Entity that employs a **[Certified Irrigation Designer - Landscape 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.

31.8 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 entrance of dirt, debris, and moisture.
- B. Store plastic piping protected from direct sunlight. Support piping to prevent sagging and bending.

31.9 FIELD 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 32 - PRODUCTS

32.1 PERFORMANCE REQUIREMENTS

- A. Irrigation Zone Control: [**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.>**.
 - f. Moisture Content: **<Insert number>** percent.
 - g. Infiltration Rate: **<Insert gph>**.
- D. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:
 - 1. Irrigation Main Piping: [**200 psig**] **<Insert value>**.
 - 2. Circuit Piping: [**150 psig**] **<Insert value>**.

32.2 PIPES, TUBES, AND FITTINGS

- A. Comply with requirements in "Piping Schedule" Article 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 A53/A53M, Standard Weight, Type E, Grade B.
 - 1. Galvanized-Steel Pipe Nipples: ASTM A733, made of ASTM A53/A53M or ASTM A106/A106M, 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 B88, Type L**, water tube, annealed temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
 - 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 B88, Type L**,] [**and**] [**ASTM B88, Type M**,] water tube, drawn temper.
 - 1. Copper Pressure Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper solder-joint fittings. Furnish wrought-copper fittings if indicated.
 - 2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint end.
 - 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 D2239, PE 3408 compound; [**SIDR 11.5**] [**and**] [**SIDR 15**].
 - 1. Insert Fittings for PE Pipe: ASTM D2609, nylon or propylene plastic with barbed ends. Include bands or other fasteners.
- H. PE Pipe with Controlled OD: ASTM D3035, PE 3408 compound, SIDR 11.

1. PE Butt, Heat-Fusion Fittings: ASTM D3261.
 2. PE Socket-Type Fittings: ASTM D2683.
- I. PE Pressure Pipe: AWWA C906, with DR of 7.3, 9, or 9.3 and PE compound number required to give pressure rating of not less than [**160 psig**] [**200 psig**].
1. PE Butt, Heat-Fusion Fittings: ASTM D3261.
 2. PE Socket-Type Fittings: ASTM D2683.
- J. PVC Pipe: ASTM D1785, PVC 1120 compound, [**Schedule 40**] [**Schedule 80**] [**Schedules 40 and 80**].
1. PVC Socket Fittings: ASTM D2466, [**Schedule 40**] [**Schedule 80**] [**Schedules 40 and 80**].
 2. PVC Threaded Fittings: ASTM D2464, Schedule 80.
 3. PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket ends.
- K. PVC Pipe, Pressure Rated: ASTM D2241, PVC 1120 compound, [**SDR 21**] [**and**] [**SDR 26**].
1. PVC Socket Fittings: ASTM D2467, Schedule 80.
 2. PVC Socket Unions: Construction similar to that of MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.

32.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, **1/8 inch** 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 B32, lead-free alloys. Include water-flushable flux in accordance with ASTM B813.
- E. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer in accordance with ASTM F656.
- F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

32.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105.
- B. Form: [**Sheet**] [**Sheet or tube**] [**Tube**].
- C. Material: [LLDPE film of **0.008-inch**] [LLDPE film of **0.008-inch minimum thickness or high-density, cross-laminated PE film of 0.004-inch**] [High-density, cross-laminated PE film of **0.004-inch**] minimum thickness.

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

32.5 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**.

32.6 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-** diameter dial, dial range of two times system operating pressure, and bottom outlet.

PART 33 - EXECUTION

33.1 EARTHWORK

- A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."
- B. Install warning tape directly above pressure piping, **[12 inches]** **<Insert value>** below finished grades, except **6 inches** 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]** **<Insert value>**, to **[12 inches]** **<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]** **<Insert value>** below finished grade, or not less than **[18 inches]** **<Insert value>** below average local frost depth, whichever is deeper.
 2. Circuit Piping: **[12 inches]** **<Insert value>**.
 3. Drain Piping: **[12 inches]** **<Insert value>**.
 4. Sleeves: **[24 inches]** **<Insert value>**.

33.2 PREPARATION

- A. Set stakes to identify locations of proposed irrigation system. Obtain Architect's approval before excavation.

33.3 INSTALLATION OF PIPING

- 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** or smaller pipe connection.
- G. Install flanges adjacent to valves and to final connections to other components with **NPS 2-1/2** or larger pipe connection.
- H. Install underground thermoplastic piping in accordance with ASTM D2774[**and ASTM**].
- 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 in accordance with AWWA C600.
- L. Install PVC piping in dry weather when temperature is above **40 deg F**. Allow joints to cure at least 24 hours at temperatures above **40 deg F** 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** and Smaller: Plastic-to-metal transition fittings.
 - b. **NPS 2** and Larger: AWWA transition couplings.
 - 2. Aboveground Piping:
 - a. **NPS 2** and Smaller: Plastic-to-metal transition [**fittings**] [**unions**].
 - b. **NPS 2** 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** and Smaller: Dielectric coupling or dielectric nipple.

- b. **NPS 2-1/2** and Larger: Prohibited except in control-valve box.
- 2. Aboveground Piping:
 - a. **NPS 2** and Smaller: Dielectric union.
 - b. **NPS 2-1/2 to NPS 4**: Dielectric flange.
 - c. **NPS 5** and Larger: Dielectric flange kit.
- 3. Piping in Control-Valve Boxes:
 - a. **NPS 2** and Smaller: Dielectric union.
 - b. **NPS 2-1/2 to NPS 4**: Dielectric flange.
 - c. **NPS 5** and Larger: Dielectric flange kit.

33.4 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 in accordance with 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 of 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 in accordance with CDA's "Copper Tube Handbook," using copper-phosphorus brazing filler metal.
- G. Copper-Tubing Soldered Joints: Apply ASTM B813 water-flushable flux to tube end unless otherwise indicated. Construct joints in accordance with ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy (0.20 percent maximum lead content) complying with ASTM B32.
- H. PE Piping Fastener Joints: Join with insert fittings and bands or fasteners in accordance with 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 in accordance with ASTM D2657.
 - 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 in

accordance with the following:

1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
2. PVC Pressure Piping: Join schedule number, ASTM D1785, PVC pipe and PVC socket fittings in accordance with ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings in accordance with ASTM D2855.
3. PVC Nonpressure Piping: Join in accordance with ASTM D2855.

33.5 INSTALLATION OF VALVES

- 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.

33.6 INSTALLATION OF AUTOMATIC IRRIGATION CONTROL SYSTEM

- A. Equipment Mounting, Interior: Install controllers on interior [**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, Exterior: 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** below[**or beside**] piping. Provide conductors of size not smaller than recommended by controller manufacturer. Install cable in separate sleeve under paved areas.

33.7 CONNECTIONS

- A. Comply with requirements for piping specified in Section 331415 "Site 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.

33.8 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.

33.9 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 with Test Assistance: 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.
 - 4. Irrigation system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

33.10 STARTUP SERVICE

- A. **[Engage a factory-authorized service representative to perform] [Perform]** startup service.
 - 1. Complete installation and startup checks in accordance with manufacturer's written

- instructions.
2. Verify that controllers are installed and connected in accordance with the Contract Documents.
3. Verify that electrical wiring installation complies with manufacturer's submittal.

33.11 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**] <Insert value> above, finish grade.

33.12 CLEANING

- A. Flush dirt and debris from piping before installing sprinklers and other devices.

33.13 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**].

33.14 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:
 1. **NPS 4** and Smaller:
 - a. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. [**Type L**] [**Type M**] hard copper tube, wrought- or cast-copper fittings, and [**brazed**] [**soldered**] joints.
 - c. [**Schedule 40**] [**Schedule 80**], PVC pipe; socket-type PVC fittings; and solvent-cemented joints.
 - d. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
 2. **NPS 5** and Larger:
 - a. Galvanized-steel pipe and galvanized-steel pipe nipples; galvanized, gray-iron threaded fittings; and threaded joints.
 - b. [**Schedule 40**] [**Schedule 80**], PVC pipe and socket fittings; and solvent-cemented joints.

- c. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
- D. Underground Irrigation Main Piping:
 - 1. **NPS 4** and Smaller:
 - a. **NPS 3 and NPS 4** ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings, glands, bolts, and nuts; and gasketed joints.
 - b. **NPS 3 and NPS 4** ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.
 - c. **Type L** soft copper tube, wrought-copper fittings, and brazed joints.
 - d. **NPS 4** PE pressure pipe; PE butt, heat-fusion or socket-type fittings; and heat-fusion joints.
 - e. **[Schedule 40] [Schedule 80]**, PVC pipe and socket fittings, and solvent-cemented joints.
 - f. Schedule 80, PVC pipe; Schedule 80, threaded PVC fittings; and threaded joints.
 - g. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
 - 2. **NPS 5** and Larger:
 - a. **NPS 6** and larger ductile-iron, mechanical-joint pipe; ductile-iron, mechanical-joint fittings, glands, bolts, and nuts; and gasketed joints.
 - b. **NPS 6** and larger ductile-iron, push-on-joint pipe; ductile-iron, push-on-joint fittings and gaskets; and gasketed joints.
 - c. PE pressure pipe; PE butt, heat-fusion fittings; and heat-fusion joints.
 - d. **[Schedule 40] [Schedule 80]**, PVC pipe and socket fittings; and solvent-cemented joints.
 - e. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
- E. Circuit Piping:
 - 1. **NPS 2** and Smaller:
 - a. **[SIDR 7] [SIDR 9]**, PE, controlled ID pipe; insert fittings for PE pipe; and fastener joints.
 - b. **[DR 9] [DR 11]**, PE, controlled OD pipe; PE butt, heat-fusion, or PE socket-type fittings; and heat-fusion joints.
 - c. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
 - d. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
 - 2. **NPS 2-1/2 to NPS 4:**
 - a. **[SIDR 7] [SIDR 9]**, PE, controlled ID pipe; insert fittings for PE pipe; and banded or fastener joints.
 - b. **[DR 9] [DR 11]**, PE, controlled OD pipe; PE socket or butt-fusion fittings; and heat-fusion joints. **NPS 3** pipe and fittings if **NPS 2-1/2** pipe and fittings are not available.
 - c. Schedule 40, PVC pipe and socket fittings; and solvent-cemented joints.
 - d. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

- F. 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.
- G. Risers to Aboveground Sprinklers and Specialties:
 - 1. **[Type L]** **[Type M]** hard copper tube, wrought-copper fittings, and **[brazed]** **[soldered]** joints.
 - 2. Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.
- H. 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.

33.15 VALVE SCHEDULE

- A. Underground, Shutoff-Duty Valves: Use the following:
 - 1. **NPS 2** and Smaller: Curb valve, curb-valve casing, and shutoff rod.
 - 2. **NPS 3** and Larger: Iron gate valve, resilient seated; iron gate valve casing; and operating wrench(es).
- B. Aboveground, Shutoff-Duty Valves:
 - 1. **NPS 2** and Smaller:
 - a. **[Brass]** **[Brass or bronze]** **[Bronze]** **[Plastic]** ball valve.
 - b. Bronze gate valve.
 - 2. **NPS 2-1/2** and Larger:
 - a. Iron ball valve.
 - b. Iron gate valve, **[NRS]** **[OS&Y]**.
- C. Throttling-Duty Valves:
 - 1. **NPS 2** and Smaller:
 - a. **[Bronze]** **[Plastic]** automatic control valve.
 - b. **[Brass]** **[Brass or bronze]** **[Bronze]** **[Plastic]** ball valve.
 - 2. **NPS 2-1/2 and NPS 3:**
 - 3. **[Bronze]** **[Plastic]** automatic control valve.
 - 4. Iron ball valve.

- D. Drain Valves:

1. **NPS 1/2 and NPS 3/4:**
 - a. Automatic drain valve.
 - b. **[Brass] [Brass or bronze] [Bronze] [Plastic]** ball valve.
 - c. Bronze gate valve.
2. **NPS 1 to NPS 2:**
 - a. **[Brass] [Brass or bronze] [Bronze] [Plastic]** ball valve.
 - b. Bronze gate valve.

END OF SECTION 328400

SECTION 329113 - SOIL PREPARATION

PART 34 - GENERAL

34.1 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 323300 "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).

34.2 ALLOWANCES

- A. **[Preconstruction] [and] [field quality-control]** testing **[is] [are]** part of testing and inspecting allowance.

34.3 UNIT PRICES

- A. Work of this Section is affected by **[unit prices specified in Section 012200 "Unit Prices."]**
<Insert name of unit price.>

34.4 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.

34.5 PREINSTALLATION MEETINGS

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

34.6 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. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project and cost for each regional material.
2. Environmental Product Declaration (EPD): For each product.
3. Product Certificates: For indigenous materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each indigenous material.
4. Environmental Product Declaration: For each product.
5. Product Certificates: For regional materials, indicating location of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include distance to Project, means of transportation, and cost for each regional material.
6. Environmental Product Declaration: For each product.
7. Environmental Product Declaration: For each product.
8. Third-Party Certifications: For each product.
9. Third-Party Certified Life Cycle Assessment: For each product.

- C. Samples: For each bulk-supplied material, **[1-quart]** **[1-gal.]** <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.

34.7 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.

34.8 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.

34.9 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.

34.10 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.

34.11 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 D698 (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. for 6-inch 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. for 6-inch depth of soil**] <Insert requirement>.

34.12 DELIVERY, STORAGE, AND HANDLING

- A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and 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 35 - PRODUCTS

PART 36 - EXECUTION

36.1 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.

36.2 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

- A. Excavation: Excavate soil from designated area(s) to a depth of [**6 inches**] <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**] [**3-inch**] <Insert dimension> sieve to remove large materials.

36.3 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**] [**6 inches**] [**8 inches**] [**12 inches**] [**18 inches**] <Insert dimension>. Remove stones larger than [**1-1/2 inches**] [**2 inches**] [**3 inches**] <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**] [**4 inches**] of subgrade. Spread remainder of planting soil.
- C. Mixing: Spread unamended soil to total depth [of **4 inches**] [of **6 inches**] [of **8 inches**] [of **12 inches**] [**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**] [**12 inches**] <Insert dimension> in loose depth for material compacted by compaction equipment, and not more than [**4 inches**] [**6 inches**] 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 D698 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.

36.4 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] [6 inches] [8 inches] [12 inches] [18 inches] <Insert dimension>. Remove stones larger than [1-1/2 inches] [2 inches] [3 inches] <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] [4 inches] of subgrade. Spread remainder of planting soil.
- C. Application: Spread planting soil to total depth [of 4 inches] [of 6 inches] [of 8 inches] [of 12 inches] [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] [12 inches] <Insert dimension> in loose depth for material compacted by compaction equipment, and not more than [4 inches] [6 inches] 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 D698[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.

36.5 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] [of 6 inches] [of 8 inches] [of 12 inches] [of 18 inches] [indicated on Drawings] <Insert dimension>. Remove stones larger than [1-1/2 inches] [2 inches] [3 inches] <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
- LED EXTERIOR LIGHTING

maximum Standard Proctor density according to ASTM D698[**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.

36.6 APPLYING COMPOST TO SURFACE OF PLANTING SOIL

- A. Application: Apply [**compost component of planting-soil mix**] [**4 inches of compost**] [**6 inches 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.

36.7 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>.

36.8 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 D698. Space tests at no less than one for each [**1000 sq. ft.**] [**2000 sq. ft.**] <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.

36.9 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.

36.10 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

PART 37 - GENERAL

37.1 SUMMARY

- A. Section Includes:
 - 1. Seeding.
 - 2. Hydroseeding.
 - 3. Sodding.
 - 4. Plugging.
 - 5. Sprigging.
 - 6. Meadow grasses and wildflowers.
 - 7. Turf renovation.

37.2 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 include 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.
- F. <Insert definition>.

37.3 PREINSTALLATION MEETINGS

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

37.4 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.

37.5 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.

37.6 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 National Association of Landscape Professionals or AmericanHort.
 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 National Association of Landscape Professionals:
 - a. Landscape Industry Certified Technician - Exterior.
 - b. Landscape Industry Certified Lawn Care Manager.
 - c. Landscape Industry Certified Lawn Care Technician.
 5. Pesticide Applicator: State licensed, commercial.

37.7 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.

37.8 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 38 - PRODUCTS

38.1 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, Warm-Season Grass: [Bermudagrass (*Cynodon dactylon*)] [Carpetgrass (*Axonopus affinis*)] [Centipedegrass (*Eremochloa ophiuroides*)] [St. Augustinegrass (*Stenotaphrum secundatum*)] [Zoysiagrass (*Zoysia japonica*)] [Zoysiagrass (*Zoysia matrella*)] [Turf-type tall fescue (*Festuca arundinacea*), shade tolerant blend] <Insert species>.
- C. Turfgrass Species, Cool-Season Grass: 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*).

38.2 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] [3 inches] [4 inches] <Insert dimension>.

38.3 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, Warm-Season Grass: [Bermudagrass (*Cynodon dactylon*)] [Carpetgrass (*Axonopus affinis*)] [Centipedegrass (*Eremochloa ophiuroides*)] [St. Augustinegrass (*Stenotaphrum secundatum*)] [Zoysiagrass (*Zoysia japonica*)] [Zoysiagrass (*Zoysia matrella*)] <Insert species>.
2. Turfgrass Species, Cool-Season Grass: Creeping bentgrass (*Agrostis palustris*).

38.4 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.

38.5 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:

- a. [1 lb/1000 sq. ft.] <Insert value> of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight.
- b. 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:

- a. 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.
- b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

38.6 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** 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 D977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

38.7 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.

PART 39 - EXECUTION

39.1 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.

39.2 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.

39.3 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.

39.4 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** below sod.

39.5 PLUGGING

- A. Plant plugs in holes or furrows, spaced [**12 inches**] [**18 inches**] <Insert dimension> apart in [**both directions**] [**triangular pattern**]. On slopes, contour furrows to near level.

39.6 SPRIGGING

- A. Plant freshly shredded sod sprigs in furrows [**1 to 1-1/2 inches**] [**1-1/2 to 2 inches**] [**2-1/2 to 3 inches**] deep. Place individual sprigs with roots and portions of stem in moistened soil, [**6 inches**] [**12 inches**] <Insert dimension> apart in rows [**10 inches**] [**18 inches**] <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.**] <Insert values> and mechanically force sprigs into lightly moistened soil.
 - 1. Spread a **1/4-inch-** 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.

39.7 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**.
- I. Apply[**soil amendments and**] initial fertilizer required for establishing new turf and mix thoroughly into top **4 inches** 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.

39.8 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**.
 - 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** 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** or less.
 2. Mow [**bermudagrass**] <Insert grass species> to a height of **1/2 to 1 inch**.
 3. Mow [**carpetgrass**] [**centipedegrass**] [**perennial ryegrass**] [**zoysiagrass**] <Insert grass species> to a height of **1 to 2 inches**.
 4. Mow [**Kentucky bluegrass**] [**buffalograss**] [**annual ryegrass**] [**chewings red fescue**] <Insert grass species> to a height of **1-1/2 to 2 inches**.
 5. Mow [**bahiagrass**] [**turf-type tall fescue**] [**St. Augustinegrass**] <Insert grass species> to a height of **2 to 3 inches**.
- 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.**] <Insert value> to turf area.

39.9 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. and bare spots not exceeding 5 by 5 inches**] <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.

39.10 MEADOW

- A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds **5 mph**.
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.] [5 oz./1000 sq. ft.] [6 oz./1000 sq. ft.] <Insert values>.
- C. Brush seed into top **1/16 inch** 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**, and roll surface smooth.
- E. Water newly planted areas and keep moist until meadow is established.

39.11 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** per week for [four] [six] [eight] weeks after planting unless rainfall precipitation is adequate.
- C. <Insert requirements>.

39.12 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.

39.13 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.

39.14 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

PART 40 - GENERAL

40.1 SUMMARY

A. Section Includes:

1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.
6. Tree-stabilization materials.

40.2 ALLOWANCES

- A. See Section 012100 "Allowances" for description of allowances affecting items specified in this Section.

40.3 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.

40.4 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.

40.5 PREINSTALLATION MEETINGS

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

40.6 ACTION SUBMITTALS

A. Product Data:

1. Plant materials.
2. Fertilizers.
3. Weed-control barriers.
4. Mulches.
5. Herbicides and pesticides.
6. Tree-stabilization materials.
7. Landscape edgings.
8. Tree grates.

9. Tree-watering devices.
- B. Product Data Submittals: For each product.
 1. Plant Materials: Include quantities, sizes, quality, and verified sources for plant materials.
- C. Samples for Verification: Actual sample of finished products for each of the following:
 1. Organic Mulch: [**1-pint**] [**1-quart**] <Insert value> volume of each organic mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Provide an accurate representation of color, texture, and organic makeup.
 2. Mineral Mulch: [**2 lb**] [**5 lb**] <Insert value> of each mineral mulch required; typical of the lot of material to be furnished, in sealed plastic bags labeled with source of mulch. Provide accurate indication of color, texture, and makeup.
 3. Weed-Control Barrier: **12 by 12 inches**.
 4. Proprietary Root-Ball-Stabilization Device: One unit.
 5. Slow-Release, Tree-Watering Device: One unit of each size required.
 6. Edging Materials and Accessories: Manufacturer's standard size, to verify color selected.
 7. Root Barrier: Width of panel by **12 inches**.

40.7 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports: Percolation tests for tree pits. Include the following:
 1. Tree identification number matching the plans.
 2. Date of test.
 3. Time when water was added to tree pit to start percolation test.
 4. Time with photo documentation showing increments of testing with water level in tree pit.
 5. Identification of tester.
- B. Qualification Statements: 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.
- C. Product Certificates: For each type of manufactured product, from manufacturer, and complying with manufacturer's certified analysis of standard products.
- D. Pesticides and Herbicides: Product label and manufacturer's written application instructions specific to Project.
- E. Sample Warranty: For special warranty.

40.8 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.

40.9 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
 - 1. Professional Membership: Member in good standing of either the National Association of Landscape Professionals or AmericanHort.
 - 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: Maintain an experienced full-time supervisor on Project site when work is in progress.
 - 4. Personnel Certification: Installer's **[field supervisor]** **[personnel assigned to the Work]** certified in **[one]** **[all]** of the following categories from the National Association of Landscape Professionals:
 - 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 in accordance with ANSI Z60.1. Do not prune to obtain required sizes.
 - 1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements **6 inches** above the root flare for trees up to **4-inch** caliper size, and **12 inches** above the root flare for larger sizes.
 - 2. Other Plants: Measure with stems, petioles, and foliage in their normal position.
- D. Plant Material Observation: 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.

40.10 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, or 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** 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.

40.11 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 in accordance with manufacturer's written instructions and warranty requirements.

40.12 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 41 - PRODUCTS

41.1 PLANT MATERIALS

- A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form,
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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; with tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); with crossing trunks; with cut-off limbs more than **3/4 inch** 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 in accordance with ANSI Z60.1.
- 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 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 ensure 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 are not yet in bloom**].
- G. **<Insert requirements>**.

41.2 FERTILIZERS

- A. Granular 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:
 - a. **[0.75 lb/1000 sq. ft.]**3 percent of actual nitrogen, 4 percent phosphorous, and 3 percent potassium, by weight.
 - b. Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.
- B. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per **lb** of vesicular-arbuscular mycorrhizal fungi and 95 million spores per **lb** of ectomycorrhizal fungi, 33 percent hydrogel, and maximum of 5.5 percent inert material.

41.3 WEED-CONTROL BARRIERS

- A. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, **3 oz./sq. yd.** minimum, composed of fibers inert to biological degradation and naturally resistant to chemicals, alkalis, and acids, formed into a stable network so that fibers retain their relative position.
- B. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, **4.8 oz./sq. yd.**

41.4 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 type>.
 - 2. Size Range: [**3 inches maximum, 1/2 inch 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** 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 type>.
 - 2. Size Range: [**1-1/2 inches maximum, 3/4 inch minimum**] [**3/4 inch maximum, 1/4 inch minimum**] <Insert dimensions>.
 - 3. Color: [Uniform tan-beige color range acceptable to Architect] [Readily available natural gravel color range] <Insert color>.

41.5 HERBICIDES AND PESTICIDES

- A. 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.
- B. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.
- C. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing 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.

PART 42 - EXECUTION

42.1 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 moisture content reaches acceptable levels to attain 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 soil and contamination as directed by Architect and replace with new planting soil.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

42.2 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.

42.3 PLANTING AREA ESTABLISHMENT

- A. General: Prepare planting area for soil placement and mix planting soil in accordance with [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]** **[in accordance with manufacturer's written instructions]** **<Insert application rate>**.

42.4 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** wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
 4. Do not excavate deeper than depth of root ball, measured from the root flare to the bottom of root ball.
 5. If area under the plant was initially dug too deep, add soil to raise it to 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 **[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-** diameter holes, **24 inches** apart, into free-draining strata or to depth of **10 ft.**, 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.

42.5 TREE, SHRUB, AND VINE PLANTING

- A. Inspection: At time of planting, verify that root flare is visible at top of root ball in accordance with ANSI Z60.1. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose 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 above**] [**2 inches 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. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place 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 above**] [**2 inches 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. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.
 - 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 above**] [**2 inches 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. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole.
 - 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 above] [**2 inches 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. Distribute granular fertilizer around each planting pit when pit is approximately one-half filled. Do not place in bottom of the hole or touching the roots.
 6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- G. Watering Pipe: During backfilling, install watering pipe **4 ft.** deep into the planting pit outside the root ball [**as indicated on Drawings]** [**and]** [with top of pipe **1 inch 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 root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

42.6 MECHANIZED TREE-SPADE PLANTING

- A. Plant trees with approved mechanized tree spade at designated locations. Do not use tree spade to move trees larger than maximum size allowed for similar field-grown, balled-and-burlapped, root-ball diameter in accordance with ANSI Z60.1, or trees larger than manufacturer's maximum size recommendation for tree spade being used, whichever is smaller.
- B. Use same tree spade to excavate the planting hole as will be used to extract and transport the tree.
- C. When extracting tree, center the trunk within the tree spade and move tree with 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 same direction as in its original location.

42.7 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 in accordance with 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.

42.8 INSTALLATION OF TREE-STABILIZATION MATERIALS

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:
1. Upright Staking and Tying:
 - a. Stake trees of **2- through 5-inch** caliper. Stake trees of less than **2-inch** caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least **18 inches** below bottom of backfilled excavation and to extend **[to the dimension indicated on Drawings]** [at least **72 inches**] **[one-third of trunk height]** **<Insert dimension or requirement>** above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.
 - b. Stake trees with two stakes for trees up to **12 ft.** high and **2-1/2 inches** or less in caliper; three stakes for trees less than **14 ft.** high and up to **4 inches** in caliper. Space stakes equally around trees.
 2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 3. 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 ft.** in height and more than **3 inches** 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** 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 in caliper]** **<Insert size>**, anchor guys to wood deadmen buried at least **36 inches** 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 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** 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 in accordance with manufacturer's written instructions.
- C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by 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 vertical stakes.
 - a. Install stakes of length required to penetrate at least [**to dimension indicated on Drawings**] [**18 inches**] <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** into stakes. Predrill 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 in accordance with 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 in accordance with manufacturer's written instructions.

42.9 INSTALLATION OF ROOT BARRIER

- A. Install root barrier where trees are planted within [**60 inches**] [**48 inches**] <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 paving or other hardscape elements to be protected from invasive roots.
- C. Install root barrier continuously for distance of [**60 inches**] <Insert dimension> in each direction from tree trunk, for total distance of [**10 ft.**] <Insert dimension> per tree. If trees are spaced closer, use single continuous piece of root barrier.
 1. Position top of root barrier [**flush with finish grade**] [**1/2 inch above finish grade**] [**in accordance with manufacturer's written instructions**].
 2. Overlap root barrier minimum of **12 inches** 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.

42.10 PLACING SOIL IN PLANTERS

- A. Place a layer of drainage gravel at least **4 inches** thick in bottom of planter. Cover bottom with filter fabric and wrap filter fabric [**4 inches**] [**6 inches**] <Insert dimension> up on all sides. Duct tape along the entire top edge of filter fabric, to secure filter fabric against the sides during soil-filling process.
- B. Fill planter with planting soil <Insert drawing designation>. Place soil in lightly compacted layers to elevation of **1-1/2 inches** below top of planter, allowing natural settlement.

42.11 GROUND COVER AND PLANT PLANTING

- A. Set out and space ground cover and plants other than trees, shrubs, and vines [**9 inches apart**] [**12 inches apart**] [**18 inches apart**] [**24 inches 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 depth not less than two nodes.
- E. Work soil around roots to eliminate air pockets and leave 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.

42.12 INSTALLATION OF MULCHES

- A. Install weed-control barriers before mulching in accordance with manufacturer's written instructions. Completely cover area to be mulched, overlapping edges minimum of [**6 inches**] [**12 inches**], 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**] [**3-inch**] <Insert dimension> average thickness, with [**12-inch**] [**24-inch**] [**36-inch**] <Insert dimension> radius around trunks or stems. Do not create a mulch cone or place mulch within [**3 inches**] [**6 inches**] <Insert distance> of trunks or stems.
 2. Organic Mulch in Planting Areas: Apply [**2-inch**] [**3-inch**] <Insert dimension> average thickness of organic mulch [extending **12 inches beyond edge of individual planting pit or trench**] [and] [**over whole surface of planting area**], and finish level with adjacent finish grades. Do not place mulch within [**3 inches**] [**6 inches**] <Insert distance> of trunks or stems.

3. Mineral Mulch in Planting Areas: Apply [**2-inch**] [**3-inch**] <Insert dimension> average thickness of mineral mulch [extending **12 inches** beyond edge of individual planting pit or trench] [and] [over whole surface of planting area], and finish level with adjacent finish grades. Do not place mulch within [**3 inches**] [**6 inches**] <Insert distance> of trunks or stems.

42.13 APPLICATION OF HERBICIDES AND PESTICIDES

- A. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas in accordance with manufacturer's written instructions. Do not apply to seeded areas.
- B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.
- C. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and in accordance with manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

42.14 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.

42.15 FIELD QUALITY CONTROL

- A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
 1. Perform tree pit percolation tests.
 2. Tree pit construction will be considered defective if it does not pass percolation tests and inspections.
 3. Do not proceed with planting in tree pits until satisfactory percolation is demonstrated.
- C. Prepare test and inspection reports.

42.16 REPAIR AND REPLACEMENT

- A. 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 unhealthy condition[**before end of 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] [4 inches] <Insert dimension> or smaller in caliper size.
 - 2. Provide [one] [two] <Insert number> new tree(s) of [6-inch] [4-inch] <Insert dimension> caliper size for each tree being replaced that measures more than [6 inches] [4 inches] in caliper size.
 - 3. Species of Replacement Trees: [Same species being replaced] [Species selected by Architect] <Insert species>.

42.17 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.

END OF SECTION 329300

SECTION 329600 - TRANSPLANTING

PART 43 - GENERAL

43.1 SUMMARY

A. Section Includes:

1. Planting materials.
2. Tree-stabilization materials.

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 329300 "Plants" for new trees from nursery-grown sources.

43.2 UNIT PRICES

- A. See Section 012200 "Unit Prices" for description of unit prices affecting items specified in this Section.
- B. Unit prices apply to additions to and deletions from the Work as authorized by Change Orders.

43.3 DEFINITIONS

- A. General: See definitions in ANSI A300 (Part 6) and in ANSI Z60.1 pertaining to field-grown trees, except as otherwise defined in this Section.
- B. Caliper: Diameter of a trunk as measured by [**diameter tape**] [or] [**average of the smallest and largest diameters**] at height **6 inches** above the root flare for trees up to, and including, **4-inch** size at this height; and as measured at height of **12 inches** above the root flare for trees larger than **4-inch** size.
- C. Caliper (DBH): Diameter breast height; diameter of a trunk as measured by [**diameter tape**] [or] [**average of the smallest and largest diameters**] at height **54 inches** above the groundline[for trees with caliper of **8 inches or greater as measured at height of 12 inches above the root flare**].
- D. Root-Ball Depth: Measured from bottom of trunk flare to bottom of root ball.
- E. Root-Ball Width: Measured horizontally across the root ball with an approximately circular form or the least dimension for non-round root balls, not necessarily centered on the tree trunk[, **but within tolerance in accordance with ANSI Z60.1**].
- F. Root Flare: Also called "trunk flare." Area at the base of tree's stem or trunk where stem or trunk broadens to form roots; area of transition between root system and stem or trunk.

43.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at **[Project site]** <Insert location>.
 - 1. Methods and procedures related to transplanting work include, but are not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, equipment, and unimpeded access needed to make progress and avoid delays.
 - b. Tree and plant protection.
 - c. Tree maintenance.
 - d. Arborist's responsibilities.
 - e. <Insert agenda items>.

43.5 ACTION SUBMITTALS

- A. Product Data:
 - 1. Planting materials.
 - 2. Tree-stabilization materials.
 - 3. Tree-watering devices.
- B. Samples for Verification: Actual sample of finished products for each of the following:
 - 1. Weed-control barriers.
 - 2. Proprietary Root-Ball-Stabilization Device: One unit.
 - 3. Slow-Release Watering Device: One unit of each size required.
- C. Pruning Schedule: Written schedule prepared by arborist detailing scope and extent of pruning each tree in preparation for and subsequent to transplanting.
 - 1. Species and size of plant.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Seasonal limitations on pruning.
 - 5. Preparatory Pruning: Time schedule and description of preparatory pruning to be performed.
 - a. Indicate time in months preceding extraction of tree.
 - b. Indicate diameter of root ball and depth of root pruning for each tree.
 - 6. Description of root and crown pruning during and subsequent to transplanting.
 - 7. Description of maintenance after pruning.

43.6 INFORMATIONAL SUBMITTALS

- A. Qualification Statements: For tree-service firm and arborist.
- B. Certification: From arborist, certifying that transplanted trees have been protected during construction and that trees were promptly and properly treated and repaired when damaged.

- C. Maintenance Recommendations: From arborist, recommended procedures to be established by Owner for care and protection of trees after completing the Work.
 - 1. Submit before completing the Work.
- D. Existing Conditions: Documentation of existing trees indicated to be transplanted, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed color photographs or video recordings. Color must accurately depict hue condition of foliage and bark.
 - 2. Include drawings and notations to indicate specific wounds and damage conditions of each tree designated to be transplanted.
- E. Tree-Transplanting Program: Submit before work begins.
- F. Sample Warranties: For special warranties.
- G. Tree-maintenance reports.

43.7 QUALITY ASSURANCE

- A. Tree-Service Firm Qualifications: An experienced landscaping contractor or tree-moving firm that has successfully completed transplanting work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
 - 1. Arborist Qualifications: **[ISA Certified Arborist] [ISA Board Certified Master Arborist] [ISA Certified Arborist-Municipal Specialist] [Licensed arborist in jurisdiction where Project is located] [Current member of ASCA] [Registered Consulting Arborist as designated by ASCA] <Insert requirement>.**
- B. Tree-Transplanting Program: Prepare a written plan by arborist for transplanting trees for whole Project, including each phase or process, tree maintenance, and protection of surrounding materials during operations. Describe in detail the materials, methods, and equipment to be used for each phase of transplanting work.
 - 1. Include transplanting times appropriate for each species at Project location unless otherwise indicated on Drawings[**or directed by arborist**].
 - 2. Include transplanting schedule for each species to be transplanted, coordinated with Project schedule.
 - 3. Include site plans clearly marked to show tree-moving routes from extraction to planting locations. Indicate proposed equipment, weight, and turning radii.
 - 4. Show details of temporary protective barriers where needed.
 - 5. Include diagrams showing clearances to utility lines and other encumbrances along route.
 - 6. Include care and maintenance provisions[**and eventual removal of tree stabilization**].

43.8 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, or walkways and pavements; or on existing turf areas or trees.
 - 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 with appropriate certificates.
- C. 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 in such a manner as to destroy their natural shape.
- D. Completely cover foliage when transporting trees while they are in foliage.
- E. Handle trees by root ball. Do not drop trees.
- F. Move trees after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after moving, set trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

43.9 FIELD CONDITIONS

- A. Field Measurements: Verify final grade elevations and final locations of trees and construction contiguous with trees by field measurements before proceeding with transplanting work. Perform transplanting only after finish grades are established.
- B. Seasonal Restrictions: Transplant trees during the following in-season periods:
 - 1. Spring: <Insert dates>.
 - 2. Summer: <Insert dates>.
 - 3. Fall: <Insert dates>.
 - 4. Winter: <Insert dates>.
- C. Weather Limitations: Proceed with transplanting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Do not transplant during excessively wet or frozen conditions. Apply products during favorable weather conditions in accordance with manufacturer's written instructions and warranty requirements.
- D. Coordination with Turf Areas (Lawns): Perform transplanting before planting turf areas unless otherwise indicated.
 - 1. When transplanting after planting turf areas, protect turf areas, and promptly repair damage caused by transplanting operations.
- E. Coordination with Planting Beds: Perform transplanting before planting bedded areas unless otherwise indicated.
 - 1. When transplanting after planting bedded areas, protect bedding plants, and promptly repair damage caused by transplanting operations.

43.10 WARRANTY

- A. Installer's Special Warranty: Tree-service firm agrees to repair or replace trees and related materials that fail within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Death and unsatisfactory growth except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner; or incidents that are beyond Contractor's control.
 - b. Death and unsatisfactory growth is defined as more than 25 percent dead or in an unhealthy condition or failure to meet general performance requirements at end of warranty period.
 - c. Structural failures, including trees falling or blowing over.
 - d. Faulty performance of materials and devices related to tree plantings including **[tree stabilization] [and] [watering devices] <Insert item>**.
 2. Warranty Periods from Date of **[Transplanting Completion] [Substantial Completion] <Insert starting time>**:
 - a. Trees: **[12] [18] <Insert number>** months.
 3. Include the following remedial actions as a minimum:
 - a. Remove dead trees and trees with unsatisfactory growth at end of warranty period; replace when directed.
 - b. Limit of one replacement of each tree will be required except for losses or replacements due to failure to comply with requirements.
 - c. Replace materials and devices related to tree plantings.
 - d. Provide extended warranty for period equal to original warranty period, for replaced trees.

43.11 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Provide tree maintenance by skilled employees of tree-service firm and as required in Part 3. Begin maintenance immediately after **[preparatory pruning] [trees are installed]** and continue until plantings are healthy and well established, but for not less than maintenance period below:
1. Maintenance Period: **[12] [18] <Insert number>** months from date of **[transplanting completion] [Substantial Completion] <Insert starting time>**.
- B. Continuing Maintenance Proposal: From tree-service firm to Owner, in the form of standard yearly (or other period) maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

PART 44 - PRODUCTS

44.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Transplanted trees are to be healthy and resume vigorous growth within **[one year] [two years] <Insert period>** of transplanting without dieback due to defective extracting, handling, planting, maintenance, or other defects in the Work.

44.2 PLANTING MATERIALS

- A. Backfill Soil: **[Excavated soil] [Excavated soil mixed with planting soil] [Planting soil]** of suitable moisture content and granular texture for placing and compacting in planting pit around tree, and 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 excavated soil to one part planting soil] <Insert requirement>**.
 - 2. Planting Soil: **<Insert drawing designation>** as specified in **[Section 329113 "Soil Preparation."]** **[Section 329115 "Soil Preparation (Performance Specification)."]**

44.3 MISCELLANEOUS PRODUCTS

- A. Organic Mulch: **[Shredded hardwood] [Ground or shredded bark] [Wood and bark chips] [Compost mulch] <Insert mulch type>** as specified in Section 329300 "Plants."
- B. Mineral Mulch: **[Rounded riverbed gravel or smooth-faced stone] [Crushed stone or gravel] [Marble chips] [Granite chips] <Insert mulch type>** as specified in Section 329300 "Plants."
- C. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees. Deliver in original, sealed, and fully labeled containers and mix in accordance with manufacturer's written instructions.
- D. Burlap: Non-synthetic, biodegradable.
- E. Pesticides: Registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended in writing 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.
 - 1. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling germination or growth of weeds within planted areas at soil level directly below the mulch layer.
 - 2. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.
- F. Weed-Control Barriers:
 - 1. Nonwoven Geotextile Filter Fabric: Polypropylene or polyester fabric, **3 oz./sq. yd.** minimum, composed of fibers formed into a stable network so that fibers retain their

- relative position. Fabric is to be inert to biological degradation and resist naturally encountered chemicals, alkalis, and acids.
2. Composite Fabric: Woven, needle-punched polypropylene substrate bonded to a nonwoven polypropylene fabric, **4.8 oz./sq. yd.**
- G. Wood Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC4a, using preservative chemicals acceptable to authorities having jurisdiction and containing no arsenic or chromium.

PART 45 - EXECUTION

45.1 TREE-TRANSPLANTING SPECIALIST

- A. Tree-Transplanting Specialist Firms: Subject to compliance with requirements, have tree transplanting performed by one of the following firms:
1. **<Insert, in separate subparagraphs, names of tree-transplanting specialist firms>.**

45.2 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 transplanting areas.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to transplanting work and tree protection and health.
- C. Proceed with transplanting only after unsatisfactory conditions have been corrected.

45.3 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, other facilities, turf areas, and other plants and planting areas from damage caused by transplanting operations.
- B. 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 excavation.
- C. Locate and clearly identify trees for transplanting. [Flag] [Tie a **1-inch blue-vinyl tape around** <Insert requirement> each tree at **54 inches** above the ground.
- D. Lay out individual transplant locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect's acceptance of layout before transplanting. Make minor adjustments as required.
- E. Apply antidesiccant to trees uniformly, using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during extracting, handling, and transportation.

1. If deciduous trees are moved in full leaf, spray with antidesiccant before extracting and again two weeks after transplanting.
- F. Wrap trees with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during extracting, handling, and transporting.

45.4 PREPARATORY PRUNING

- A. Root Pruning: Perform preparatory root pruning under direction of arborist as far in advance of extracting each tree as Project schedule allows.
 1. Dig exploratory pits or trench [**by hand**] [**or**] [**with air spade**] around perimeter of tree at indicated root-ball width to determine locations of main lateral roots.
 2. Dig trench [**by hand**] [**or**] [**with tree spade**] around perimeter of tree at indicated root-ball width to the depth of the root system. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 3. Root-Ball Width: Minimum [**9 inches**] **<Insert dimension>** of root-ball diameter, or least dimension for non-round root balls, for each **1 inch** of tree caliper being transplanted.
 4. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
 5. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
 6. Cut exposed roots manually 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.
 7. Do not paint or apply sealants on cut root ends.
 8. Backfill trench with excavated soil.
- B. Crown Pruning (Tip Pruning):
 1. Do not perform preparatory crown pruning (tip pruning).
 2. Perform preparatory crown pruning [**as indicated on Drawings, under direction of arborist**] [**as directed by arborist**]. Follow procedures as specified in "Crown Pruning" Article.

45.5 EXCAVATION AND PLANTING EQUIPMENT

- A. Tree Spade: Track-mounted mechanized tree mover; sized in accordance with manufacturer's size recommendation for each tree being transplanted.

45.6 EXCAVATION OF PLANTING PITS

- A. General: Excavate under supervision of arborist.
 1. Excavate planting pits or trenches with sides sloping. 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. Scarify sides of planting pit smeared or smoothed during excavation.
 2. Excavate approximately [**two**] [**three**] **<Insert requirement>** times as wide as root ball.
 3. Keep excavations covered or otherwise protected until replanting trees.

- B. Subsoil and topsoil removed from excavations may[**not**] be used as planting soil.
- C. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees are encountered in excavations.
 - 1. Hardpan Layer: Drill **6-inch-** diameter holes, **24 inches** apart, into free-draining strata or to a depth of **10 ft.**, whichever is less, and backfill with free-draining material.
- D. Seepage: Notify Architect if subsoil conditions evidence unexpected water seepage into tree-planting pits.
- E. Drainage: Fill planting pit or trench with [**6 inches**] <Insert dimension> of water and time the infiltration rate of soil. If drainage rate is less than [**0.25 inch**] <Insert dimension> per hour, notify Architect to determine need for subsurface drainage.
- F. Saline or Sodic Soils: Completely fill excavations with water and allow to percolate away before positioning trees.

45.7 EXTRACTION OF TREES

- A. General: Extract trees under supervision of arborist.
- B. Orientation Marking: Mark the north side of each tree with non-permanent paint before extracting.
- C. Root-Ball Width: Minimum [**10 inches**] <Insert dimension> of root-ball diameter, or least dimension for non-round root balls, for each **1 inch** of tree caliper being transplanted.
 - 1. Out-of-Season Planting: If planting before or after the in-season period for tree, provide minimum root-ball diameter of [**12 inches**] <Insert dimension> for each **1 inch** of tree caliper being transplanted.
- D. Root-Ball Depth: As determined by arborist for each species and size of tree and for site conditions at original and planting locations.
- E. Digging:
 - 1. Dig and clear a pit [**by hand**] [**or**] [**with tree spade**] to depth of root system. Do not use backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Use narrow-tine spading forks to comb soil to expose roots with minimal damage to root system.
 - 3. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking.
 - 4. Cut exposed roots manually with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not paint or apply sealants on cut root ends.
 - 5. Construct box tight against root system sides and bottom as pit is dug. Brace and support box to prevent breaking of root ball.
 - 6. Temporarily support and protect exposed roots from damage until they are permanently redirected and covered with soil. Cover roots with burlap and keep them moist until planted.
- F. Extracting with Tree Spade: Use same tree spade to extract the tree as will be used to transport and plant the tree.

1. Do not use tree spade to move trees larger than manufacturer's maximum size recommendation for tree spade being used.
2. When extracting the tree, center the trunk within tree spade and move tree with solid ball of earth.

45.8 PLANTING

- A. Planting Standard: Perform planting in accordance with ANSI A300 (Part 6) unless otherwise indicated.
- B. Before planting, verify that root flare is visible at top of root ball. If root flare is not visible, remove soil in a level manner from root ball to where the top-most root emerges from the trunk. After soil removal to expose root flare, verify that root ball still meets size requirements.
- C. Ensure that root flare is visible after planting.
- D. Remove injured roots by cutting cleanly; do not break. Do not paint or apply sealants on cut root ends.
- E. Orientation: Position the tree so that its north side, marked before extracting, is facing north in its new location.
- F. Set tree plumb and in center of planting pit with **[bottom]** **[top]** of root flare **[1 inch]** **[2 inches]** **<Insert dimension>** above adjacent finish grades.
 1. Use specified backfill soil for backfill.
 2. If area under the tree was initially dug too deep, add backfill to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
 3. After placing some backfill around root ball to stabilize plant, begin backfilling.
 4. 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.
 5. Redirect exposed root ends downward in backfill areas where possible. Hand-expose roots as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is impractical, cut roots approximately **3 inches** back from new construction and as required for root pruning.
 6. Continue backfilling process. Water again after placing and tamping final layer of soil.
- G. Watering Pipe: During backfilling, install watering pipe **4 ft.** deep into the planting pit outside the root ball **[as indicated on Drawings]** **[and]** **[with top of pipe 1 inch above the mulched surface]**.
- H. Planting with Tree Spade: Use same tree spade for planting as was used to extract and transport the tree. Do not use tree spade for trees larger than manufacturer's maximum size recommendation for tree spade being used.
- I. Slopes: When planting on slopes, set the tree so root flare on the uphill side is flush with surrounding soil on the slope; edge of root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of root ball.

45.9 CROWN PRUNING

- A. Prune branches [**as indicated on Drawings, under direction of arborist**] [**as directed by arborist**].
 - 1. Prune to remove only[**injured**,] broken, dying, or dead branches. Do not prune for shape.
 - 2. Do not remove or reduce living branches to compensate for root loss caused by cutting root system or to improve natural tree form.
 - 3. Pruning Standards: Perform pruning in accordance with ANSI A300 (Part 1).
- 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 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>.

45.10 INSTALLATION OF TREE-STABILIZATION MATERIALS

- A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated on Drawings[**or directed by arborist**].
 - 1. Upright Staking and Tying: Stake only as required to prevent wind tip out. Use a minimum of [**two**] [**three**] stakes of length required to penetrate at least **18 inches** below bottom of backfilled excavation and to extend [**to dimension indicated on Drawings**] [**one-third of trunk height**] <Insert dimension or requirement> above grade. Set stakes vertical and space to avoid penetrating root balls or root masses.
 - 2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.
 - 3. Support trees with two strands of tie wire, connected to 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[**or directed by arborist**].
 - 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** 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 in caliper**] <Insert size>, anchor guys to wood deadmen buried at least **36 inches** 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 a [**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 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** 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 in accordance with manufacturer's written instructions.
- C. Root-Ball Stabilization: Install at- or below-grade stabilization system to secure each new planting by root ball unless otherwise indicated on Drawings[**or directed by arborist**].
- 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 vertical stakes.
 - a. Install stakes of length required to penetrate at least [to dimension indicated on Drawings] [**18 inches**] <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** 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 as indicated.
 - 2. Proprietary Root-Ball-Stabilization Device: Install root-ball-stabilization system sized and positioned as recommended by manufacturer unless otherwise indicated and in accordance with 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 in accordance with manufacturer's written instructions.

45.11 INSTALLATION OF MULCHES

- A. Install weed-control barriers before mulching in accordance with manufacturer's written instructions. Completely cover area to be mulched, overlapping edges minimum of [**6 inches**] [**12 inches**] and secure seams with galvanized pins.

- B. Organic Mulch: Apply **[2-inch]** **[3-inch]** **<Insert dimension>** average thickness of organic mulch [extending **12 inches beyond edge of individual planting pit**] **[and]** **[over whole surface of planting area]**, and finish level with adjacent finish grades. Do not place mulch within **[3 inches]** **[6 inches]** **<Insert distance>** of trunks or stems.
- C. Mineral Mulch in Planting Areas: Apply **[2-inch]** **[3-inch]** **<Insert dimension>** average thickness of mineral mulch [extending **12 inches beyond edge of individual planting pit**] **[and]** **[over whole surface of planting area]**, and finish level with adjacent finish grades. Do not place mulch within **[3 inches]** **[6 inches]** **<Insert distance>** of trunks or stems.

45.12 TREE MAINTENANCE

- A. Perform tree maintenance as recommended by arborist. Maintain arborist observation of transplanting work.
- B. Maintain trees 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. Treat as required to keep trees free of insects and disease.
- C. From time of **[preparatory root pruning]** **[or]** **[tree extraction]**, measure soil moisture adjacent to edge of each root ball **[weekly]** **<Insert period>**. Record findings and weather conditions.
- D. Fill areas of soil subsidence with backfill soil. Replenish mulch materials damaged or lost in areas of subsidence.
- E. Apply treatments as required to keep tree materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices whenever 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.
- F. Pesticide Application: Apply pesticides and other chemical products and biological control agents in accordance with authorities having jurisdiction and manufacturer's written instructions. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.
 - 1. Pre-Emergent Herbicides (Selective and Non-Selective): Apply in accordance with manufacturer's written instructions. Do not apply to seeded areas.
 - 2. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already-germinated weeds and in accordance with manufacturer's written instructions.
- G. Reports: Have arborist prepare **[monthly]** **<Insert period>** inspection reports.

45.13 REPAIR AND REPLACEMENT

- A. Repair or replace transplanted trees and other plants indicated to remain or be relocated that are damaged by construction operations, in a manner recommended by arborist and approved by Architect.
 - 1. Submit details of proposed pruning and repairs.
 - 2. Perform repairs of damaged trunks, branches, and roots within 24 hours in accordance with

- 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. Remove and replace trees that are more than [25] <Insert number> percent dead or in unhealthy condition[**before end of 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] [4 inches] <Insert dimension> or smaller in caliper size.
 2. Provide [one] [two] <Insert number> new tree(s) of [6-inch] [4-inch] <Insert dimension> caliper size for each tree being replaced that measures more than [6 inches] [4 inches] in caliper size.
 3. Species of Replacement Trees: [Same species being replaced] [Species selected by Architect] <Insert species>.

45.14 **CLEANING AND PROTECTION**

- A. During transplanting, keep adjacent paving and construction clean and work area in an orderly condition.
- B. Protect trees from damage due to transplanting operations and operations of other contractors and trades. Maintain protection during transplanting and maintenance periods. Treat, repair, or replace damaged plantings.
- C. After planting and before [Substantial Completion] <Insert time>, remove tags, markings, tie tape, labels, wire, burlap, and other debris from transplanted trees, planting areas, and Project site.

END OF SECTION 329600