

Project Manual

Bid Document

WWII JAPANESE
AMERICAN
INCARCERATION
MONUMENT

4045 190TH Street
Torrance, California 90504

Chee Salette
Project No. 2024-16
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DIVISION 01

General Requirements
per City of Torrance

SECTION 01 10 00 – SUMMARY

PART 1 – GENERAL

1.1 PROJECT SUMMARY

A. The Work consists of construction of a WWII Memorial and associated site improvements at Columbia Park.

B. Work includes, but is not limited to:

1. Site preparation and grading
2. Concrete foundations and flatwork
3. Installation of memorial and interpretive elements
4. Pedestrian pathways and seating areas
5. Landscaping and irrigation improvements

C. The Project is located within an existing public park and shall be executed to maintain a safe and accessible environment for public use at all times.

1.2 CONTRACT TYPE

A. The Work will be performed under a lump sum public works contract.

1.3 WORK RESTRICTIONS

- A. Comply with City of Torrance work hours, noise ordinances, and operational constraints.
 - B. Minimize disruption to park operations and surrounding areas.
 - C. Maintain safe pedestrian access at all times.
 - D. Coordinate work to avoid conflicts with City events and park usage.
-

1.4 EXISTING CONDITIONS

- A. Contractor shall field verify all site conditions prior to construction.
 - B. Protect all existing improvements to remain.
 - C. Any discrepancies shall be reported to the City prior to proceeding.
-

SECTION 01 20 00 – PRICE AND PAYMENT PROCEDURES

PART 1 – GENERAL

1.1 SCHEDULE OF VALUES

- A. Submit within ten (10) working days of Notice to Proceed.
- B. Format shall follow CSI Division breakdown and align with the Project Schedule.

1.2 APPLICATIONS FOR PAYMENT

- A. Submit monthly progress payment applications.
- B. Payments shall be based on percentage of completion by line item.
- C. Include updated Schedule of Values and Submittal Log with each application.

1.3 RETENTION

- A. Retention shall be withheld in accordance with contract requirements.
- B. Final payment will be issued upon satisfactory completion, acceptance, and closeout.

1.4 CHANGE PROCEDURES

- A. Changes shall be authorized only by written Change Order or Construction Change Directive.
- B. Unauthorized work will not be compensated.
- C. Provide cost breakdowns and time impacts for all change requests.

SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 – GENERAL

1.1 SUBSTITUTION REQUESTS

- A. Submit substitution requests in writing within ten (10) days of Notice to Proceed.
- B. Include product data, performance comparisons, cost impacts, and schedule impacts.

1.2 APPROVAL

- A. Substitutions are subject to City approval.
- B. Approved substitutions shall meet or exceed specified requirements.

SECTION 01 26 13 – REQUESTS FOR INTERPRETATION (RFI)

PART 1 – GENERAL

1.1 PROCEDURES

- A. Submit RFIs in writing using an approved format.
- B. Clearly identify drawing references, specification sections, and specific questions.

1.2 RESPONSE TIME

- A. Allow minimum five (5) working days for response.
- B. Contractor shall plan work to avoid delays due to pending RFIs.

SECTION 01 31 00 – PROJECT MANAGEMENT AND COORDINATION

PART 1 – GENERAL

1.1 CITY REPRESENTATIVE AND INSPECTOR AUTHORITY

A. The City's designated Project Manager and Inspector are authorized to act on behalf of the City.

B. The City Inspector shall have authority to:

1. Observe all Work for compliance
2. Reject non-conforming Work
3. Require correction of defective Work
4. Suspend Work that violates safety or contract requirements

C. Contractor shall provide full access to the Work at all times.

D. Inspection does not relieve Contractor of responsibility for compliance.

1.2 PRE-CONSTRUCTION MEETING

A. Attend pre-construction conference prior to start of work.

1.3 PROJECT MEETINGS

A. Provide weekly progress updates.

B. Attend meetings as directed by the City.

1.4 COORDINATION

A. Coordinate all trades and sequencing.

B. Resolve conflicts prior to installation.

C. Provide minimum 48-hour notice for inspections and critical activities.

SECTION 01 32 00 – CONSTRUCTION SCHEDULING

PART 1 – GENERAL

1.1 BASELINE SCHEDULE

A. Submit within ten (10) working days of Notice to Proceed.

1.2 SCHEDULE UPDATES

A. Update schedule monthly or as requested by the City.

1.3 INSPECTION HOLD POINTS

A. The following activities are designated as mandatory hold points:

1. Subgrade preparation
2. Underground utilities prior to backfill
3. Reinforcing steel prior to concrete placement
4. Concrete placement
5. Memorial installation
6. Electrical rough-in and final
7. Landscape and irrigation installation
8. Final completion and punch list

B. Do not proceed beyond hold points without City approval.
C. Provide minimum 48-hour notice for inspection.

1.4 PERFORMANCE REQUIREMENTS

A. Contractor shall diligently prosecute the Work.
B. Delays do not entitle Contractor to additional compensation.

1.5 LIQUIDATED DAMAGES

A. \$1,000 per calendar day until Substantial Completion.

SECTION 01 33 00 – SUBMITTAL PROCEDURES

PART 1 – GENERAL

1.1 SUBMITTAL REQUIREMENTS

A. Submit shop drawings, product data, and samples as required.

1.2 SUBMITTAL LOG

A. Maintain a Submittal Log throughout the Project.

B. Include:

1. Submittal number
2. Specification section
3. Description
4. Date submitted
5. Review status
6. Date returned

- C. Submit initial log within ten (10) days of Notice to Proceed.
 - D. Update log with each pay application.
-

1.3 REVIEW TIME

- A. Allow ten (10) working days for review.
-

SECTION 01 35 00 – UTILITY SHUTDOWN AND COORDINATION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

- A. Coordinate all utility interruptions with the City prior to execution.
-

1.2 NOTIFICATION

- A. Provide minimum 72-hour advance notice for planned shutdowns.
 - B. Notify:
 - City Project Manager
 - Affected departments
 - Adjacent facilities
-

1.3 APPROVAL

- A. Do not proceed without written City approval.
-

1.4 EXECUTION

- A. Perform shutdowns during approved hours only.
 - B. Minimize outage duration.
-

1.5 EMERGENCY CONDITIONS

- A. Immediately notify City of unplanned outages.
 - B. Restore service promptly.
-

SECTION 01 40 00 – QUALITY REQUIREMENTS

PART 1 – GENERAL

1.1 QUALITY CONTROL

- A. Contractor is solely responsible for quality of the Work.

1.2 TESTING AND INSPECTION

- A. Provide all required inspections and testing.
 - B. Coordinate with City Inspector.
-

1.3 DEFECTIVE WORK

- A. Correct defective work at no cost to the City.
 - B. Complete corrections within thirty (30) days of notice.
-

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 – GENERAL

1.1 TEMPORARY UTILITIES

- A. Provide temporary power and water as required.
-

1.2 SITE CONTROL

- A. Provide fencing, barriers, and signage.
 - B. Restrict unauthorized access.
-

1.3 SAFETY REQUIREMENTS

- A. Comply with OSHA and applicable regulations.
-

1.4 SITE PROTECTION

- A. Protect adjacent property and improvements.
 - B. Maintain clean and orderly site.
-

SECTION 01 57 19 – TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 – GENERAL

1.1 ENVIRONMENTAL PROTECTION

- A. Protect existing trees and landscaping.
 - B. Control dust, erosion, and runoff.
-

1.2 HAZARDOUS MATERIALS

- A. Report any discovered hazardous materials immediately.
-

SECTION 01 60 00 – PRODUCT REQUIREMENTS

PART 1 – GENERAL

1.1 MATERIALS

A. Provide new and unused materials.

1.2 DELIVERY AND STORAGE

A. Protect materials from damage and deterioration.

SECTION 01 70 00 – EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 – GENERAL

1.1 CLOSEOUT PROCEDURES

- A. Complete all punch list items.
 - B. Clean project site.
-

SECTION 01 78 00 – CLOSEOUT SUBMITTALS

PART 1 – GENERAL

1.1 SUBMITTALS

- A. As-built drawings
- B. Warranties
- C. Operation and maintenance manuals

END OF SECTION

DIVISION 02

Existing Conditions

SECTION 025639 – TEMPORARY TREE & PLANT PROTECTION

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Temporary Tree & Plant Protection, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Protecting and maintaining existing trees and vegetation not specifically designated for removal, to remain.
 - 2. Protection shall be extended to trees and/or vegetation located within or directly adjacent to the Project Site, whether the tree trunk and/or vegetation are located within the designated Limits of Work.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 328400 – Irrigation Systems.
 - 2. Section 329200 – Lawns and Grasses.
 - 3. Section 329300 – Exterior Plants.
 - 4. Section 329400 – Landscape Planting Accessories.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ANSI – American National Standards Institute.
 - 2. ASTM – American Society for Testing & Materials.
 - 3. ISA – International Society of Arboriculture.
 - 4. USDA – United States Department of Agriculture.
- B. Definitions:
 - 1. Tree – A woody perennial plant which usually has (but not limited to) a single dominant trunk and has a mature height of fifteen-feet (15') or more and has a trunk diameter (caliper) of three-inches (3") or more when measured at twenty-four-inches (24") above the finished grade.
 - 2. Drip-line – The outermost extent of the tree's foliated canopy, which encompasses the tree leaves or fronds, trunk, branches, roots, and soil. In no case shall a drip line encompass an area under a tree canopy, which is less than ten-feet (10') in diameter. Since each tree is unique in size, scale, and form, the delineated drip-line of each tree shall be refined at the discretion of the Landscape Architect.
 - 3. Injury – Bruising, scarring, tearing, gouging, or breaking of roots, branches, or trunk(s), soil compaction around the drip-line, or contamination around the drip-line which results in the decline to the health of the tree.
 - 4. Root Zone– The soil volume surrounding a plant containing the roots.
- C. Reference Standards:

1. *American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300)*, American National Standards Institute, Latest Edition.
2. *American National Standard for Tree Care Operations (ANSI Z133)*, American National Standards Institute, Latest Edition.
3. *Tree Pruning Guidelines*, International Society of Arboriculture, 1995 Edition.
4. *Pruning Standards for Shade Trees*, National Arborists Association, Latest Edition.

3. SUBMITTALS

- A. Contractor shall provide site photographs or videotape, sufficiently detailed and described, of existing conditions of trees and vegetation, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing, tree pruning, or tree protection. Submit photographs or videotape to the Landscape Architect prior to commencement of Work.
- B. Product Data: Submit complete and legible materials list of items to be provided for Work described herein this Section.
- C. Submit complete detailed schedule and description of Work to be done within drip-line, (if any), including list of equipment to be used.
- D. Submit schedule and description of proposed pruning and/or other remedial work to existing plant materials. Submit qualifications describing years of experience and list of similar projects completed for the following:
 1. A State of California licensed Pest Control Advisor shall propose application of all herbicides or pesticides.
 2. A Certified Arborist shall propose pruning of trees or other vegetation. The Certified Arborist shall have a minimum of five (5) year's post-certification experience performing pruning and observation work for projects of comparable size with trees of similar size and nature.
 3. Tree Pruning Company, and List of Certified Tree Workers, who will perform Work relating to requirements herein this Section. Tree Pruning Company shall have a minimum of five (5) years experience specializing in performing the work of this Section for projects of comparable size with trees of similar size and nature.

4. QUALITY ASSURANCE AND CONTROL

- A. Pre-Installation Conference: Conduct conference at Project Site.
- B. Pruning and remedial work shall be done under the direct supervision of an Arborist certified by the International Society of Arborists (ISA); or Arborist who is a member in good standing in the American Society of Consulting Arborists, in compliance with ISA and ANSI Standards. Arborist shall be on Site continuously while existing trees or roots are being pruned or remedial work is being performed.

5. PROJECT SITE CONDITIONS

- A. Contractor shall become aquatinted with existing site conditions, verifying quantities and locations of all protected trees and vegetation, and other information as may be necessary. Notify the Landscape Architect of unsatisfactory conditions, in writing, prior to commencement of Work.

- B. Tree Flagging: Prior to commencement of Work, Contractor shall flag existing trees and vegetation to remain and protected throughout the duration of Work. Adequately flag tree trunks with bright-colored tape (neon colors preferred). Verify flagged trees and vegetation with the Landscape Architect.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during tree-pruning or tree-protection operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways, if required, by authorities having jurisdiction.
- D. Locate above utilities prior to any Work, and perform Work in a manner which will avoid possible damage. Notify utility locator service for area where Project is located before site clearing where applicable. Notify the Landscape Architect if conflicts exist.
- E. Improvements on Adjoining Property: Authority for performing indicated removal and alteration Work on property adjoining Owner's property shall be obtained by the adjoining property Owner(s) prior to commencement of Work.
- F. Protect existing Work and Work of other trades: Damage to existing construction caused by Work of this Section shall be promptly repaired and/or replaced at the expense of the Contractor.
- G. Environmental Requirements: Perform actual pruning operations (if needed) during those seasons suitable for the specific tree type, in accordance with locally acceptable horticultural practices.
- H. Pre-Tree Pruning/Tree Protection Conference: Contractor shall conduct a Pre-Tree Pruning/Tree Protection Conference at the Project Site with Certified Arborist (who will be on-site supervising the Work of the Project) and the Landscape Architect.
 - 1. Contractor shall be responsible for notifying parties, in writing, at least seven (7) days in advance to schedule the Conference.
 - 2. Contractor shall provide to parties in attendance within seven (7) days a written legible inventory of Work to be accomplished, including species (botanical and common name), location, size, specific pruning needs or tree protection needs as identified during the Conference, recommended pruning or tree protection methods to meet the identified needs, and any additional conditions noted.

6. SCHEDULE

- A. Install Tree Protection Barricades prior to commencement of Work.
- B. Work shall be done according to approved Schedule.

7. GUARANTEE

- A. Contractor shall Guarantee that plants covered under the Provisions of this Section shall be healthy and in a flourishing condition of active growth for two (2) years from the date of Final Acceptance.

- B. Requirements of the guarantee shall apply if failure of the Contractor to take specified precautions and Work within restrictions of this Section contributes to the destruction, decline, or injury to a tree to remain, in the judgment of the Landscape Architect.
- C. If a tree designated to be protected accordingly is destroyed or injured so that in the judgment of the Landscape Architect it should be replaced, it shall be removed at the expense of the Contractor. Contract shall pay compensation to the Owner of the property where the tree was located at the rate as specified herein this Section (see Compensation).

8. COMPENSATION

- A. Contractor shall replace existing plant material designated to remain that dies or sustained injury from the result of the Contractor's negligence to provide adequate required protection, pruning, or maintenance during the course of construction operations.
- B. Trees: Contractor shall thoroughly remove damaged tree, including trunk, branches, and roots, at no cost to the Owner, and at the direction of the Landscape Architect.
 - 1. Contractor shall furnish and install per requirements in Section 329300 – Exterior Plants, with an equal size tree (in height, spread, and caliper), and of the same form, species, and in the same quantity as those tree(s) that were damaged, at the direction of the Landscape Architect. Compensation shall include the actual cost of the item boxed out of the ground; transportation or delivery of boxed item to the site; unloading, planting and staking; maintenance, including watering, fertilizing, pruning, pest control, and other care to bring replacement to same general condition of the original item.
- C. Other Plant Material (other than Trees): Contractor shall replace other vegetation (other than trees) that died or sustained injury from the result of the Contractor's negligence to provide adequate required vegetation protection, pruning, or maintenance during the course of construction operations. Compensation shall be awarded to the Owner as follows:
 - 1. Contractor shall thoroughly remove damaged vegetation at no cost to the Owner, and at the direction of the Landscape Architect.
 - 2. Contractor shall furnish and install per requirements in Section 329300 – Exterior Plants, with equal size plant material as those which damaged ((5) gallon container stock minimum (as applicable)) of the same form, species, and in the same quantity as vegetation that was damaged, at the direction of the Landscape Architect.

2.PRODUCTS

1. TREE PROTECTION MATERIALS

- A. Barricade for Protection of Existing Vegetation:
 - 1. Fabric: Utility (snow) type fencing, minimum four-feet (4'-0") high, consisting of a vinyl meshed fabric in a bright orange color. Fabric shall be approved by the Landscape Architect.
 - 2. Posts: Metal or wood, sufficient in gauge (as appropriate) and size to support the fabric material in a taut and plumb condition. Posts shall be subject to approval by the Landscape Architect.
 - 3. Signs: Posted plastic laminated signs, attached to fabric fencing, with words "WARNING-KEEP OUT-TREE PROTECTION ZONE".

- B. Mulch: Where available, Contractor shall stockpile and reuse shredded wood chips produced from on-site tree removals and remedial work, if chips are disease free and acceptable to the Landscape Architect. Where on-site chips are not available, Contractor shall provide Shredded Wood Mulch as specified in Section 329400 – Landscape Planting Accessories.

3.EXECUTION

1. PREPARATION

- A. Provide erosion-control measures as needed to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.

2. TREE AND VEGETATION PROTECTION

- A. Protect existing trees and other vegetation indicated to remain in place against the following:
 - 1. Storage or parking of automobiles or other vehicles.
 - 2. Stockpiling of building materials, refuse, or excavated materials.
 - 3. Use of trees as support posts, power posts, or sign posts, anchorage for ropes, guy wires, or power lines, or other similar functions.
 - 4. Dumping of poisonous materials on or around plant roots, trunks, branches, or foliage. Such materials include, but are not limited to, paint, petroleum products, dirty water, or other deleterious materials.
 - 5. Cutting, breaking, or skinning of roots caused by utility trenching, foundation digging, placement of curbs and trenches, and other miscellaneous excavation without prior written approval by the Landscape Architect.
 - 6. Damage by skinning or bruising of bark on trunks or branches, caused by maneuvering vehicles or stacking material or equipment too close to the plant.
 - 7. Compaction of the soil within the drip-line of the plants due to movement of trucks or grading machines, pedestrian or vehicular traffic, storage of equipment or materials.
 - 8. Excessive water or heat from equipment, utility line construction, or burning of trash under or near vegetation to remain.
 - 9. Damage to root system from flooding, erosion, and excessive wetting and drying resulting from watering and other operations.
- B. Prior to commencement of construction activities, the Contractor shall erect and maintain a temporary fenced barricade around the drip-line of individual trees, around perimeter drip-line of groups of trees, or around other vegetation to remain.
 - 1. Prevent damage to roots during installation of barricade posts. Space posts approximately 4'-0" on-center (O.C.) and securely attach fabric.
 - 2. Barricades shall be installed plumb, taut, and sturdy to prevent unauthorized access around drip-line of trees and protected vegetation. Repair sagging or damaged barricades immediately.
 - 3. Immediately after barricade fencing is installed, cover entire soil area inside of the fence area with a four-inch (4") layer of mulch. Keep mulch eighteen-inches (18") away from root crown. Irrigate protected trees and vegetation to a moist soil depth of eighteen-inches (18") deep.

4. During the course of construction, relocation of the barricade may be required to facilitate construction. Contractor shall relocate barricade as directed by the Landscape Architect at no additional expense to the Owner.
 5. Remove barricade when construction operations are complete or when directed by the Landscape Architect.
- C. Irrigation: Contractor shall supply fresh potable water in adequate amounts and rates of application as required to maintain the health of protected plant material throughout the duration of the construction operations. Contractor shall maintain a watering schedule and document dates and duration of irrigation applications.
1. Construct a temporary watering basin, as required, on the surface of the existing undisturbed grade, with imported soil, to aid in the retention of water around existing protected trees and planting.
- D. Do not excavate within drip line of trees, unless approved, in writing, by the Landscape Architect.
- E. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
1. Cover exposed roots with burlap and water regularly.
 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
 3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
- F. Protect root systems of existing trees and vegetation from damage due to chemically injurious materials in solution caused by run-off or spillage during mixing or placement of construction materials, and drainage of stored materials.
- G. Protect root systems from flooding, erosion, excessive wetting or drying resulting from de-watering or other operations.
- H. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the Landscape Architect.
1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified Arborist.
3. CLEARING AND GRUBBING
- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of eighteen-inches (18") inches below exposed sub-grade.
 4. Use only hand methods for grubbing within drip line of remaining trees.

- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

4. PRUNING AND REMEDIAL WORK

- A. Pruning and remedial work shall be done under continuous supervision of the approved Arborist, according to approved submittals, and per ANSI A300 Pruning Standards.
- B. Provide pruning, cabling and bracing, irrigation, pest and disease control and other remedial treatments as recommended by the approved Arborist, required to assure the long-term health of the trees and existing vegetation, and the safety of persons and property.

5. LANDSCAPE ESTABLISHMENT PERIOD

- A. Keep areas within tree protection barricades free from weeds, trash, and debris. Do not use herbicides.
- B. Maintain mulch layer and protective devices throughout entire duration of Contract.

END OF SECTION

DIVISION 03

CONCRETE

SECTION 03 1000 – CONCRETE FORMING AND ACCESSORIES

1. GENERAL

1. SUMMARY

A. Section Includes:

1. Formwork for cast-in-place concrete as indicated.
2. Installation of items to be embedded in concrete, such as anchor bolts, inserts, embeds, and sleeves.

B. Related Requirements:

1. Division 01 - General Requirements.
2. Section 03 2000: Concrete Reinforcing.
3. Section 03 3000: Cast-In-Place Concrete.

2. REFERENCES

A. American Concrete Institute (ACI) Publication:

1. ACI 318 – Building Code Requirements for Structural Concrete, Chapter 6, Formwork, Embedded Pipes, and Construction Joints.
2. ACI 347 – Guide to Formwork for Concrete.

B. American Plywood Association (APA):

1. Form No. V345 - Concrete Forming Design/Construction Guide.

C. National Institute of Standards and Technology (NIST):

1. NIST Voluntary Product Standard PS 1.

3. SUBMITTALS

- ##### A.
- Submit detailed structural calculations and drawings approved and signed by a California registered Civil Engineer where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure exceeds 14 feet, or where individual horizontal span lengths exceed 16 feet, or where provision for vehicular traffic through falsework or shoring occurs. For all other falsework and shoring submit layout signed by California registered Civil Engineer, manufacturer's authorized representative or a licensed contractor experienced in the usage and erection of falsework and vertical shoring. A copy of the plans and calculation shall be available at the jobsite at all times.

- ##### B. Shop Drawings:
- Submit Shop Drawings indicating locations of forms, construction and expansion joints, embedded items, and accessories.

- C. Product Data: Submit manufacturer's Product Data for form materials and accessories.
4. REGULATORY REQUIREMENTS
- A. California Building Code (CBC), Chapter 19A.
 - B. California Code of Regulations, Title 8, Division 1, Chapter 4, Subchapter 4, Construction Safety Orders, Article 6, Excavations, Sections 1713 and 1717.
5. DELIVERY, STORAGE AND HANDLING
- A. Storage shall prevent damage and permit access to materials for inspection and identification.

2.PRODUCTS

1. GENERAL
- A. Form materials may be reused during progress of the Work provided they are completely cleaned and reconditioned, recoated for each use, capable of producing formwork of required quality, and are structurally sound.
 - B. Form Lumber: WCLIB Construction Grade or Better, WWPA No. 1 or Better.
 - C. Plywood: NIST Voluntary Product Standard PS 1, Group 1, Exterior Grade B-B Plyform or better, minimum 5-ply and 3/4 inch thick for exposed locations and at least 5/8 inch thick for unexposed locations, grade marked, not mill oiled. Furnished plywood with medium or high density overlay is permitted.
 - D. Coated Form Plywood: For exposed painted concrete, plastic overlaid plywood of grade specified above, factory coated with a form coating and release agent Nox-crete", or equal.
 - E. Tube Forms: Sonoco "Seamless Sonotubes," Ceme-Tube, Quik-Tube, or equal, of the type leaving no marks in concrete, one-piece lengths for required heights.
 - F. Joist Forms: Code recognized steel or molded plastic types as required.
 - G. Special Forms: For exposed integrally-colored concrete, plywood as above with high density overlay, plywood with integral structural hardboard facing or fibrous glass reinforced plastic facing, providing specified finish.
 - H. For Exposed Concrete Finish:
 - 1. Plywood: New, waterproof, synthetic resin bonded, exterior type Douglas fir or Southern pine plywood manufactured especially for concrete formwork and conforming to NIST Voluntary Product Standard PS 1, Grade B-B grade, Class I.

2. Glass-Fiber-Fabric Reinforced Plastic Forms: Matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to structural tolerances and appearance of finished concrete surfaces.
 3. Steel: Minimum 16 gage sheet, well matched, tight fitting, stiffened to support weight of concrete, without deflection detrimental to tolerances and appearances of finished concrete surfaces.
 4. Plywood: "Finland Form," "Combi Form" by North American Plywood Corporation, "Plyform" by Roy O. Martin, "ProForm" by Pacific Wood Laminates, or equal. The material shall be furnished with hard smooth birch face veneers with phenolic resin thermally fused onto panel sides. Edges shall be factory sealed.
- I. Form Ties: Prefabricated rod, flat band, wire, internally threaded disconnecting type, not leaving metal within 1 1/2-inch of concrete surface.
 - J. Form Coating: Non-staining clear coating free from oil, silicone, wax, not grain-raising, "Formshield" by A.C. Horn, Inc., "Release" by Edoco/Dayton Superior, "Cast-Off" by Sonneborn/BASF Building Systems or equal. Where form liners are furnished, provide form coatings recommended by form liner manufacturer.
 - K. Form Liner: Rigid or resilient type by L.M. Scofield, Symons, Greenstreak, or equal.
 - L. Void Forms: Manufactured by SureVoid Products, Inc., Sonotube, Void Form International, or equal. Forms shall be "WallVoid" for temporary support of concrete walls and grade beams spanning between supports, and "SlabVoid" for creating gaps between concrete slabs or steps and underlying soils. Void forms shall be fabricated of corrugated paper with moisture resistant exterior, and shall be capable of withstanding working load of 1,500 psf. Provide accessories as required.

3.EXECUTION

1. GENERAL

- A. Forms shall be constructed so as to shape final concrete structure conforming to shape, lines and dimensions of members required by Drawings and Specifications, and shall be sufficiently tight to prevent leakage of mortar. They shall be properly braced or tied together to maintain position and shape. Forms and their supports shall be designed so that previously placed structures will not be damaged.
- B. Use form coating at all surfaces in contact with concrete.

2. TOLERANCES

- A. Permitted abrupt or gradual irregularities in formed surfaces as measured within a 5 feet length with a straightedge shall per ACI 347, Table 3.1:

Class of Surface			
A	B	C	D
1/8 inch	1/4 inch	1/2 inch	1 inch

1. Class A: Use for concrete surfaces prominently exposed to public view.
2. Class B: Use for coarse-textured concrete-formed surfaces intended to receive plaster, stucco or wainscoting.
3. Class C: Use as a general standard for permanently exposed surfaces where other finishes are not specified.
4. Class D: Use for surfaces where roughness is not objectionable and will be permanently concealed.

3. ERECTION

- A. Plywood shall be installed with horizontal joints level, vertical joints plumb and with joints tight. Back joints by studs or solid blocking, and fill where necessary for smoothness. Reused plywood shall be thoroughly cleaned, damaged edges or surfaces repaired and both sides and edges oiled with colorless form oil. Nail plywood along edges, and to intermediate supports, with common wire nails spaced as necessary to maintain alignment and prevent warping.
- B. Openings for Cleaning: Provide temporary openings at points in formwork to facilitate cleaning and inspection. At base of walls and wide piers, bottom form board on one face for entire length shall be omitted until form has been cleaned and inspected.
- C. Chamfers: Provide 3/4 inch by 3/4 inch chamfer strips for all exposed concrete corners and edges unless otherwise indicated.
- D. Reglets and Rebates: As specified in Section 03 3000: Cast-In-Place Concrete.

4. REMOVAL OF FORMS

- A. Forms shall not be removed until concrete has sufficiently hydrated to maintain its integrity and not be damaged by form removal operations. Unless noted otherwise and/or permitted by the Architect, columns and wall forms shall not be removed in less than five days, floor slabs in less than seven days, beams and girders in less than 15 days, pan forms for joists may be removed after three days, but joist centering shall not be removed until after 15 days, and ramp, landing, steps and floor slabs shall not be removed in less than seven days. Shoring shall not be removed until member has acquired sufficient strength to support its weight, load upon it, and added load of construction.

- B. Compressive strength of in-place concrete shall be determined by testing field-cured specimens representative of concrete location or members, as specified in Section 03 3000: Cast-In-Place Concrete.

5. PROTECTION

- A. Protect the Work of this section until Substantial Completion.

6. CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

END OF SECTION

SECTION 03 2000 – CONCRETE REINFORCING

1.GENERAL

1. SUMMARY

- A. Section Includes:
 - 1. Concrete steel reinforcement.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 1000: Concrete Forming.
 - 3. Section 03 3000: Cast-In-Place Concrete.
 - 4. Section 04 2200: Concrete Unit Masonry.

2. REGULATORY REQUIREMENTS

- A. Fabrication and placement of reinforcing shall be in accordance with requirements of CBC, Chapter 19A.

3. REFERENCES

- A. ASTM International:
 - 1. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.
 - 2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
 - 3. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
 - 4. ASTM A1064 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- B. American Concrete Institute (ACI) Publication:
 - 1. ACI SP-66 – ACI Detailing Manual.
 - 2. ACI 318 – Building Code Requirements for Structural Concrete, as modified by CBC.
 - 3. ACI 117 – Specifications for Tolerance for Concrete Construction and Materials.
- C. American Welding Society (AWS):
 - 1. AWS D1.4 – Structural Welding Code – Reinforcing Steel ADMINISTRATIVE REQUIREMENTS
- D. Concrete Reinforcing Steel Institute (CRSI):
 - 1. Manual of Standard Practice.

4. SUBMITTALS

- A. Shop Drawings: Submit steel reinforcement Shop Drawings. Include assembly diagrams, schedule of reinforcement, stirrup spacing, bending charts and slab and framing plans. Indicate lengths and location of splices, laps of bars, size and lengths of reinforcing steel. Indicate steel type and grade of reinforcement. Indicate epoxy or non-epoxy reinforcement on general notes.
- B. Closeout Submittals: Record exact locations of reinforcing that vary from Contract Documents.
- C. Manufacturer's Mill Certificate: Submit, certifying that products meet or exceed specified requirements.

5. QUALITY ASSURANCE

- A. Comply with the following as a minimum requirement:
 - 1. Concrete Reinforcing Steel Institute (CRSI) Manual of Standard Practice.
 - 2. American Welding Society (AWS).
 - 3. American Concrete Institute (ACI).
 - 4. CBC, Chapter 19A, Concrete.
- B. Source Quality Control: Refer to Division 01 Sections for general requirements and to the following paragraphs for specific procedures. Testing laboratory retained by the OWNER shall select test Samples of bars, ties, and stirrups from the material at the Project Site or from the place of distribution, with each Sample consisting of not less than two 18 inch long pieces, and perform the following tests according to ASTM A615, or ASTM A706, as applicable:
 - 1. Identified Bars: If Samples are obtained from bundles as delivered from the mill, identified as to heat number, accompanied by mill analyses and mill test reports, and properly tagged with the identification certificate so as to be readily identified, perform one tensile and one bend test for each 10 tons or fraction thereof of each size of bars. Submit mill reports when Samples are selected.
 - 2. Unidentified Bars: When positive identification of reinforcing bars cannot be performed and when random Samples are obtained; perform tests for each 2.5 tons or fraction thereof, one tensile and one bend test from each size of bars.
- C. Certification of Welders: Shop and Project site welding shall be performed by welding operators certified by AWS.

6. DELIVERY, STORAGE AND HANDLING

- A. Avoid exposure to dirt, moisture or conditions harmful to reinforcing.
- B. Reinforcing steel bars, wire, and wire fabric shall be stored on the Project site to permit easy access for examination and identification of each shipment. Material of each shipment shall be separated for size and shape.

2.PRODUCTS

1. GENERAL

- A. Provide reinforcing of sizes, gages and lengths indicated, bent to indicated shapes.

2. MATERIALS

- A. Steel Reinforcing Bars:
 - 1. ASTM A615, deformed grade 60 or 75 billet steel, as indicated on the drawings.
 - 2. Weldable reinforcing bars shall conform to ASTM A706.
- B. Bars or Rod Mats: ASTM A184.
- C. Welded Wire Fabric for Reinforcement: ASTM A1064.
- D. Tie Wire: ASTM A1064, fully annealed, copper-bearing steel wire, 16 gage minimum.
- E. Chairs, Spacers, Supports, and Other Accessories: Standard manufacture conforming to ACI 315 fabricated from steel wire of required types and sizes. For reinforcement supported from grade, provide properly sized dense precast blocks of concrete.

3. FABRICATION OF REINFORCING BARS

- A. Comply with CRSI Manual of Standard Practice for Reinforced Concrete Construction for fabrication of reinforcing steel.
- B. Bending and Forming: Fabricate bars of the indicated sizes and bend and form to required shapes and lengths by methods not injurious to materials. Do not heat reinforcement for bending. Bend bars No. 6 size and larger in the shop only. Bars with unscheduled kinks or bends are not permitted. Provide only tested and permitted bar materials.
- C. Welding: Provide only ASTM A706 steel where welding is indicated. Perform welding by the direct electric arc process in accordance with AWS D1.4 and specified low-hydrogen electrodes. Preheat 6 inches each side of joint. Protect joints from drafts during the cooling process; accelerated cooling is not permitted. Do not tack weld bars. Clean metal surfaces to be welded of loose scale and foreign material. Clean welds each time electrode is changed and chip burned edges before placing welds. When wire brushed, the completed welds must exhibit uniform section, smooth welded metal, feather edges without undercuts or overlays, freedom from porosity and clinkers, and good fusion and penetration into the base metal. Cut out welds or parts of welds deemed defective, using chisel, and replace with proper welding. Prequalification of welds shall be in accordance with CBC requirements.

3.EXECUTION

1. INSTALLATION

- A. Bars shall be bent cold. Bars partially embedded in concrete shall not be field bent except as indicated on reviewed Shop Drawings.

- B. Before installation and just prior to placing concrete, clean reinforcing of loose scale, rust, oil, dirt and any coating that could reduce bond.
 - C. Accurately position, install, and secure reinforcing to prevent displacement during the placement of concrete.
 - D. Provide metal chairs to hold reinforcement the required distance above form bottoms. In beams and slab construction, provide chairs under top slab reinforcement as well as under bottom reinforcement. Space chairs so that reinforcement will not be displaced during installation. Provide metal spacers to secure proper spacing. Stirrups shall be accurately and securely wired to bars at both top and bottom. At slabs, footings, and beams in contact with earth, provide concrete blocks to support reinforcement at required distance above grade.
 - E. Install and secure reinforcement to maintain required clearance between parallel bars and between bars and forms. Lapped splices shall be installed wherever possible in a manner to provide required clearance between sets of bars. Stagger lapped splices. Dowels and bars extending through construction joints shall be secured in position against displacement before concrete is installed and subsequently cleaned of concrete encrustations while they are still soft.
 - F. Do not install reinforcing in supported slabs and beams until walls and columns have been installed to underside of slabs and beams or until construction joints have been thoroughly cleaned. Reinforcing shall be inspected before placement of concrete and cleaned as required.
 - G. Use deformed bars unless otherwise indicated, except for spiral reinforcement.
2. CLEAN UP
- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.
3. PROTECTION
- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

SECTION 03 3000 – CAST-IN-PLACE CONCRETE

1.GENERAL

1. SUMMARY

- A. Section Includes:
 - 1. Cast-in-place normal weight and lightweight concrete, placement and finishing.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 03 1000: Concrete Forming and Accessories.
 - 3. Section 03 2000: Concrete Reinforcing.

2. REFERENCES

- A. American Concrete Institute (ACI) Publication:
 - 1. ACI 117 – Specifications for Tolerances for Concrete Construction and Materials.
 - 2. ACI 301 – Specifications for Structural Concrete.
 - 3. ACI 302.1R – Guide for Concrete Floor and Slab Construction.
 - 4. ACI 305R - Specification for Hot Weather Concreting.
 - 5. ACI 306.1 – Standard Specification for Cold Weather Concreting.
 - 6. ACI 308R – Guide to External Curing of Concrete.
 - 7. ACI 318 - Building Code Requirements for Structural Concrete, as modified by CBC Sections 1903A and 1905A.
- B. American Society for Testing and Materials (ASTM) Standards:
 - 1. ASTM C31 – Standard Specification for Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 5. ASTM C88 - Standard Test Method for Soundness of Aggregates by use of Sodium Sulphate or Magnesium Sulphate.
 - 6. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 7. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete.
 - 8. ASTM C150 - Standard Specification for Portland Cement.
 - 9. ASTM C156 – Standard Test Method for Water Loss (from a Mortar Specimen) Through Liquid Membrane-Forming Curing Compounds for Concrete.
 - 10. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 - 11. ASTM C172 – Standard Practice for Sampling Freshly Mixed Concrete.
 - 12. ASTM C173 – Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.

13. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
14. ASTM C289 - Standard Test Method for Potential Alkali-Silica Reactivity of Aggregates (Chemical Method).
15. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
16. ASTM C330 - Standard Specification for Lightweight Aggregates for Structural Concrete.
17. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
18. ASTM C567 - Standard Test Method for Determining Density of Structural Lightweight Concrete.
19. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
20. ASTM C845 - Standard Specification for Expansive Hydraulic Cement
21. ASTM C989 - Standard Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.
22. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
23. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
24. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
25. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
26. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
27. ASTM D1308 – Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes.
28. ASTM C1567 - Standard Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method).
29. ASTM D1751 - Standard Test Method for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
30. ASTM D7234 – Standard Test Method for Pull-Off Adhesion Strength of Coatings on Concrete Using Portable Pull-Off Adhesion Testers.
31. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
32. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
33. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill under Concrete Slabs.
34. ASTM E1745 - Standard Specification for Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.
35. ASTM F710 – Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
36. ASTM F1869 – Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
37. ASTM F2170 – Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using In Situ Probes.

38. ASTM F3010 – Standard Practice for Two-Component Resin Based Membrane-Forming Moisture Mitigation Systems for Use under Resilient Floor Coverings.

3. SUBMITTALS

- A. Shop Drawings: Submit Shop Drawings indicating locations of cast-in-place concrete Work and accessory items such as vapor barriers. Include details and locations of reinforcing, embedded items, and interfacing with other Work. Indicate dimensions and compressive strength.
- B. Mix Design Data: Submit concrete mix designs as specified herein and in Article 2.02.
 - 1. Submit name, address and telephone number of the concrete production facility which the contractor intends to engage to design the concrete mixes. Submit name and qualifications of the proposed concrete technologist.
 - 2. Mix Design: Submit a concrete mix design for each strength and type of concrete indicated in the drawings or specified. Include water/cement ratio, source, size and amount of coarse aggregate and admixtures. Predict minimum compressive strength, maximum slump and air content percentage. Clearly indicate locations where each mix design will be used.
 - a. Water/cement ration for concrete slabs on grade shall be 0.50 maximum.
 - 3. Test Reports: Submit copies of test reports showing that the proposed mixes produce concrete with the strengths and properties specified. Include tests for cement, aggregates and admixtures. Provide gradation analysis.
- C. Material Samples: Submit Samples illustrating concrete finishes and hardeners, minimum 12-inch by 12-inch.
- D. Certificates: Submit certification that each of the following conforms to the standards indicated:
 - 1. Portland cement: ASTM C150.
 - 2. Normal weight concrete aggregates: ASTM C33.
 - 3. Lightweight concrete aggregates: ASTM C330.
 - 4. Aggregates: Submit evidence that the aggregate is not reactive in the presence of cement alkalis. In the absence of evidence, aggregate shall be tested by one of the methods in ASTM C33 Appendix XI, Methods for Evaluating Potential for Deleterious Expansion Due to Alkali Reactivity of an Aggregate. Aggregates deemed to be deleterious or potentially deleterious may be used with the addition of a material that has been shown to prevent harmful expansion in accordance with Appendix XI of ASTM C33, when approved by the building official, in accordance with ACI 318 Section 26.4.1.2
 - 5. Curing materials: ASTM C171.
- E. Admixtures: Submit product data for proposed concrete admixtures.

4. QUALITY ASSURANCE

- A. Continuous inspection shall be provided at the batch plant and for transit-mixed concrete to run check sieve analysis of aggregate, check moisture content of fine

aggregate, check design of mix, check cement being used with test reports, check loading of mixer trucks, and certify to quantities of materials placed in each mixer truck.

- B. Inspection shall be performed by a representative of a testing laboratory selected by the OWNER. OWNER will pay for inspection costs. Notify the laboratory 24 hours in advance of time concrete is to be mixed. Notify the laboratory of postponement or cancellation of mixing within at least 24 hours of scheduling time.
- C. CONTRACTOR shall assist the testing laboratory in obtaining and handling samples at the project site and at the source of materials.
- D. Continuous batch plant inspection requirement may be waived in accordance with CBC Section 1705A.3.3.1. Waiver shall be in writing, including DSA approval. When batch plant inspection is waived by DSA, the following requirements shall be met:
 - 1. Approved inspector of the testing laboratory shall check the first batching at the start of work and furnish mix proportions to the licensed weightmaster.
 - 2. Licensed weightmaster shall positively identify materials as to quantity and certify to each load by a ticket.
 - 3. Tickets shall be transmitted to the Inspector by a truck driver with load identified thereon. The Inspector will not accept the load without a load ticket identifying the mix and will keep a daily record of placements, identifying each truck, its load and time of receipt and approximate location of deposit in the structure and will transmit a copy of the daily record to DSA.
 - 4. At the end of the project, the weightmaster shall furnish an affidavit to DSA certifying that all concrete furnished conforms in every particular to proportions established by mix designs.
- E. Special Inspections and Tests shall be in accordance with CBC Chapter 17A, Reinforcement and Anchor testing per CBC Section 1903A and Specification Section 01 4523.

5. DELIVERY, STORAGE AND HANDLING

- A. Store cement and aggregate materials so as to prevent their deterioration or intrusion by foreign matter. Deteriorated or contaminated materials shall not be furnished.
- B. Packaged materials shall bear the manufacturers and brand name label and shall be stored in their original unbroken package in a weather tight place until ready for use in the work.

6. PROJECT CONDITIONS

- A. Cold Weather Requirements: Batching, mixing, delivering and placing of concrete in cold weather shall comply with the applicable requirements of ACI 306.1.
- B. Hot Weather Requirements: Batching, mixing, delivering and placing of concrete in hot weather shall comply with the applicable requirements of ACI 305R.

- C. Concrete temperature of freshly mixed concrete shall be determined per ASTM C1064.

2.PRODUCTS

1. MATERIALS

- A. Cement: ASTM C150. Portland Cement.
- B. Aggregates: Conform to the following standards:
1. Normal weight concrete: ASTM C33.
 2. Lightweight concrete: ASTM C330, with fine aggregates per ASTM C33.
 3. Aggregate shall be tested for Potential Alkali Reactivity of Cement-Aggregate Combinations per ASTM C289.
 4. Nominal maximum size of coarse aggregate shall be no larger than:
 - a. 1/5 the narrowest dimension between sides of forms, nor
 - b. 1/3 the depth of slabs, nor
 - c. 3/4 the clear spacing between individual reinforcing bars or wires, bundles of bars, individual tendons, or ducts.
 - d. CONTRACTOR may request the ARCHITECT and DSA waiver of the above limitations reported per ACI 318, provided that the workability and methods of consolidation are such that the concrete can be placed without honeycombs or voids.
- C. Water: Water for concrete mixes, curing and cleaning shall be potable and free from deleterious matter.
- D. Admixtures: Shall be shown capable of maintaining essentially the same composition and performance throughout the work as the product used in establishing concrete proportions in accordance with ACI 318, Section 26.4.1.5.
1. Admixtures containing chlorides or sulfides are not permitted.
 2. Air-entraining admixtures shall comply with ASTM C260. Air-entrained admixtures shall not be used for floor slabs to receive steel trowel finish.
 3. Admixtures for water reduction and setting time modification shall conform to ASTM C494.
 4. Admixtures for producing flowing concrete shall conform to ASTM C1017.
 5. Fly ash, pozzolan and ground granulated blast-furnace slag shall conform to the requirements of ACI 318 Section 26.4.2.2
 - a. Fly ash or other pozzolan used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:
 - 1) Shall conform to ASTM C618 for Class N or F materials (Class C is not permitted).
 - 2) [] percent by weight of fly ash or other pozzolans shall substitute for ASTM C150 Portland cement.
 - b. Ground-granulated blast-furnace slag used as a partial substitution for ASTM C150 Portland cement shall meet the following requirements:
 - 1) Shall conform to ASTM C989.

- 2) [] percent by weight of ground-granulated blast-furnace slag shall substitute for ASTM C150 Portland cement.
 6. Admixtures containing ASTM C845 expansive cements shall be compatible with the cement and produce no deleterious effects.
 7. Silica fumes used as an admixture shall conform to ASTM C1240.
- E. Reinforcement Fibers: Chop strands of alkali-resistant polypropylene or nylon fibers added to the concrete mix for protection against shrinkage cracks.
- F. Expansion Joint Fillers: Preformed strips, non-extruding and resilient bituminous type, of thickness indicated, conforming to ASTM D1751.
- G. Curing:
1. Curing Paper: Shall conform to ASTM C171 and consist of two sheets of kraft paper cemented together with a bituminous material in which are embedded cords or strands of fiber running in both directions. The paper shall be light in color, shall be free of visible defects, with uniform appearance.
 2. Elevated slabs and slabs on grade may be cured at CONTRACTOR's option with curing and proactive water vapor emission and alkalinity control system. Products shall be approved by OWNER's Office of Environmental Health and Safety.
 - a. VaporSeal 309, by Floor Seal Technology, Inc., or equal.
 - 1) ASTM C156: 0.39 kg/m².
 - 2) ASTM C309: Exceeds requirements.
 - 3) ASTM C1315: Exceeds requirements.
 - 4) ACI 308R-01 Compliant.
 - b. Remedial Treatment: Water vapor emission and alkalinity control treatment, MES 100 by Floor Seal Technology, Inc. or equal.
 - 1) ASTM E96: <0.1 Perms.
 - 2) ASTM D1308: 14pH Resistant.
 - 3) ASTM D7234: 500+psi 100% concrete failure.
 - 4) ASTM F2170: 100%RH resistant.
 - 5) VOC Content: <100 g/L, meets SCAQMD Rule #1113.
 - 6) ASTM F3010: Meets Requirements.
 - c. Self-leveling Compounds: Ardex Engineered Cements, K15, or V1200, Schonox ZM Rapid, US Self Leveler Armstrong, S-194, or equal.
- H. Floor Hardener: Water soluble, inorganic, silicate-based curing, hardening, sealing and dustproofing compound. Aquaseal W20 by Monopole Inc., Kure-N-Harden by BASF, Chem Hard by L&M, Liqui-Hard by W. R. Meadows, or equal.
- I. Underlayment: Two component latex underlayment for filling low spots in concrete for both interior and exterior applications, from featheredge to a maximum of 3/8 inch in thickness. Underlayment shall be non-shrink and suitable for repairing exposed concrete surfaces and for underlayment of carpet, resilient, tile and quarry floor coverings. La-O-Tex by TexRite, Underlay C, RS by Mer-Krete Systems, Underlayment 962 by C-Cure, or equal.
- J. Vapor Barrier: Refer to Section 07 2600, Vapor Barriers.

- K. Stair Treads and Nosings: Two-part stair tread and nosing with ribbed abrasive bars. Fabricated from 6063-T5 or 6063-T6 extruded aluminum, mill finish. Anti-slip abrasive filler consisting of aluminum oxide, silicon carbide, or a combination of both, in an epoxy-resin binder. Color shall extend uniformly throughout filler.
 - 1. American Safety Tread: TP-311R.
 - 2. Balco Inc.: DST-330.
 - 3. Nystrom: STTB-P3.375E.
 - 4. Wooster Products Inc.: WP-RN3SG.
 - 5. Equal.
- L. Grout: ASTM C1107, non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing additives, capable of developing a minimum compressive strength of 7,000 psi at 7 days; of consistency suitable for application and a 30-minute working time.

2. CONCRETE MIX

- A. Mix shall be signed and sealed by a Civil or Structural Engineer currently registered in the State of California.
- B. Strength of Concrete: Strengths and types of concretes shall be as indicated in the Drawings. Unless otherwise indicated or specified, concrete shall be provided with minimum 28-day strength of 3000 psi (f'c).
- C. Concrete mix shall meet the durability requirements of ACI 318, Chapter 19.
- D. Concrete proportioning shall be determined on the basis of field experience and/or trial mixtures shall in accordance with ACI 318, Section 26.4.3. Proportions of materials shall provide workability and consistency to permit concrete to be placed readily into forms and around reinforcement under conditions of placement to be employed, without segregation or excessive bleeding.
- E. Ready-Mixed Concrete: Mix and deliver in accordance with requirements of ASTM C94.

3.EXECUTION

1. GENERAL

- A. Surfaces to receive concrete shall be free of debris, standing water, and any other deleterious substances before start of concrete placing.
- B. Time of Placing: Do not place concrete until reinforcement, conduits, outlet boxes, anchors, hangers, sleeves, bolts, and other embedded materials are securely fastened in place. Contact the Inspector at least 24 hours before placing concrete; do not place concrete until inspected by the Project Inspector.

- C. Pouring Record: A record shall be kept on the Project site of time and date of placing concrete in each portion of structure. Such record shall be maintained on the Project site until Substantial Completion and shall be available for examination by the ARCHITECT and DSA.

2. TOLERANCES

- A. Concrete construction tolerances shall be as specified in ACI 117 and as modified herein.
- B. Floor Flatness (FF) and Floor Levelness (FL) shall be as indicated below:

	Specified Overall Value		Minimum Local Value	
	F _F	F _L	F _F	F _L
Slabs on ground: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry flooring.	20	15	15	10
Slab on ground: carpet.	25	20	17	15
Slab on ground: thinset tile and resilient flooring.	35	25	24	17
Suspended slabs: mechanical and electrical rooms, parking structures and mortar bed set tile and quarry flooring.	20	15	N/A	N/A
Suspended slabs: carpet.	25	20	N/A	N/A
Suspended slabs: thinset tile and resilient flooring.	35	20	N/A	N/A

- C. Refer to ACI 302.1R, Tables 8.1 and 8.2 Slab on Ground and Suspended Flatness/Levelness Construction Guide, for recommended concrete placing and finishing methods.
- D. Floor Flatness and Floor Levelness shall be tested in accordance with ASTM E1155. Floor measurements shall be made within 48 hours after slab installation and shall precede removal of shores and forms.

3. PREPERATION

- A. For installation of vapor barrier refer to Section 07 2600, Vapor Barriers.
- B. Reglets and Rebates:

1. Form reglets and rebates in concrete to receive flashing, frames and other equipment as detailed and required. Coordinate dimensions and locations required with other related Work.
 2. If concrete slabs on grade adjoin a wall or other perpendicular concrete surface, form a reglet in wall to receive and carry horizontal concrete Work. Reglet shall be full thickness of the slab and shall be 3/4 inch wide, unless otherwise indicated. Requirement does not apply to exterior walks, unless specifically indicated.
- C. Screeds: Install screeds accurately and maintain at required grade or slab elevations after steel reinforcement has been installed, but before starting to place concrete. Install screeds adjacent to walls and in parallel rows not to exceed 8 feet on centers.
4. INSTALLATION
- A. Conveying and Placing:
1. Concrete shall be placed only under direct observation of the Project Inspector. Do not place concrete outside of regular working hours, unless the Inspector has been notified at least 48 hours in advance.
 2. Concrete shall be conveyed from mixer to location of final placement by methods that will prevent separation or loss of materials.
 3. Concrete shall be placed as nearly as practicable to its final position to avoid segregation due to re-handling or flowing. No concrete that has partially hydrated or has been contaminated by foreign materials shall be placed, nor shall re-tempered concrete or concrete which has been remixed after initial set be placed.
 4. In placing concrete in columns, walls or thin sections, provide openings in forms, elephant trunks, tremies or other recognized devices, to prevent segregation and accumulation of partially hydrated concrete on forms or metal reinforcement above level of concrete being placed. Such devices shall be installed so that concrete will be dropped vertically. Unconfined vertical drop of concrete from end of such devices to final placement surface shall not exceed 6 feet.
 5. Concrete shall be placed as a continuous operation until placing of panel or section is completed. Top surfaces of vertically formed lifts shall be level.
 6. Concrete shall be thoroughly consolidated by suitable means during placement and shall be thoroughly worked around reinforcement and embedded fixtures and into corners of forms.
 7. Where conditions make consolidation difficult or where reinforcement is congested, batches of mortar containing same proportions of cement, sand, and water as provided in the concrete, shall first be deposited in the forms to a depth of at least one inch.
- B. Cold Weather:
1. Provide adequate equipment for heating concrete materials and protecting concrete during freezing or near-freezing weather. All ground with which concrete is to come in contact shall be free from frost. No frozen materials or materials containing ice shall be used.
 2. The temperature of concrete at the time of placement shall not be below the minimum temperatures given in Table 3.1 of ACI 306.1.

3. Concrete shall be maintained at a temperature of at least 50° F. for not less than 72 hours after placing or until it has thoroughly hardened. Cover concrete and provide sufficient heat as required. When necessary, aggregates shall be heated before mixing. Special precautions shall be taken for protection of transit-mixed concrete.
- C. Hot Weather:
 1. Concrete to be placed during hot weather shall comply with the requirements of ACI 318, Section 26.5.5.
 2. Maintain concrete temperatures indicated in Table 2.1.5 of ACI 305R to prevent the evaporation rate from exceeding 0.2 pound of water per square feet of exposed concrete per hour.
 3. Cool concrete using methods indicated in ACI 305R Appendix B.
 4. Place and cure concrete as specified in ACI 305R Chapter 4.
- D. Compaction and Screeding:
 1. Tamp freshly placed concrete with a heavy tamper until at least 3/8 inch of mortar is brought to surface. Concrete shall then be tamped with a light tamper and screeded with a heavy straightedge until depressions and irregularities are eliminated, and surface is true to finish grades or elevations. Remove excess water and debris.
 2. Where slabs are to receive separate cement finish or mortar setting bed, continued tamping to raise mortar to surface is not performed. Laitance shall be removed by brushing with a stiff brush or by light sandblasting to expose clean top surface of coarse aggregate.
- E. Floating and Troweling:
 1. When concrete has hydrated sufficiently, it shall be floated to a compact and smooth surface. After floating, wait until concrete has reached proper consistency before troweling. Top surfaces shall receive at least 2 troweling operations with steel hand trowel. Prior to and during final troweling, apply a fine mist of water frequently with an atomizing type fog sprayer. Omit troweling for slabs to receive a separate cement finish.
 2. For interior finish slabs, final troweling shall provide a hard, impervious, and non-slip surfaces, free from defects and blemishes. Finished surface shall be within tolerances indicated in Article 3.02. Avoid burnishing. Do not add cement or sand to absorb excess moisture.
 - a. Floor of Walk-In Refrigerator: Finish as specified above, to a smooth finish.
 - b. Floor of Gymnasium Locker Rooms: After floating, and while the surface is still plastic, provide a fine textured finish by drawing a fine fiber bristle broom uniformly over the surface in one direction only. Floors sloped for drainage should be brushed in the direction of flow.
 3. Vertical concrete surfaces shall be finished smooth and free from marks or other surface defects.
5. CURING
 - A. Length of time, temperature and moisture conditions for curing concrete shall be in accordance with ACI 318, Section 26.5.3.

- B. Forms containing concrete, top of concrete between forms, and exposed concrete surfaces after removal of forms shall be maintained in a thoroughly wet condition for at least 7 consecutive days after placing.
- C. If weather is hot or surface has dried out, spray surface of concrete slabs and paving with fine mist of water, starting not later than 2 hours after final troweling and continuing until sunset. Surface of finish shall be kept continuously wet until curing medium has been installed.
- D. Immediately after finishing, monolithic floor slabs shall be covered with curing paper. Paper shall be lapped 4 inches at joints and sealed with waterproof sealer. Edges shall be cemented to finish. Repair or replace paper damaged during construction operations.
- E. When curing slabs with proactive water vapor emission and alkalinity control system:
 - 1. Coordinate and schedule application of curing compound with concrete pour schedule, while conforming to manufacturer's application instructions.
 - 2. When the surface of the concrete has hardened sufficiently to sustain foot traffic pre-cure slabs with liquefied product application following manufacturer's written instructions. Application shall be by trained applicators.
 - 3. Monitor Environmental Conditions: Set up weather station 20 to 30 inches above freshly placed concrete. Record temperature, humidity and wind velocity measurements at 15-minute maximum intervals.
 - 4. Calculate Evaporation Rate: Use recorded weather information in combination with nomograph per ACI 308R, Figure 4.1, Guide to Curing Concrete, to evaluate relevant evaporation rate.
 - 5. When the bleed water rate of the concrete is approximately equal to the surface water evaporation rate, spray curing compound material throughout surface of slabs and decks, following manufacturer's written instructions. Application shall be by trained applicators.
 - 6. Perform the following tests at least 28 days after placement of concrete and prior to floor covering installation. Submit to OAR test results indicating locations that do not comply with scheduled flooring installation requirements.
 - a. Calcium chloride testing per ASTM F1869.
 - b. Relative humidity testing per ASTM F2170.
 - c. Alkalinity testing per ASTM F710.
 - d. Perform concrete bond layer humidity meter testing to determine substrate surface acceptability.
 - 7. Areas emitting moisture and alkalinity at rates exceeding floor covering manufacturer's published ASTM F1869 limits, shall receive a corrective coating, at no cost to the OWNER, as follows:
 - a. Mask and protect adjacent walls and floor surfaces from effects of scarification and application of remedial treatment.
 - b. Scarify slab surface in area of application by shot blasting or other method acceptable to corrective coating manufacturer.
 - c. Prepare and fill cracks, control joints and cold joints.
 - d. Apply two-component modified epoxy penetrant and coating with roller and squeegee over required treatment area; saturate surfaces to ensure a through mechanical bond.

- e. Clean and fill divots, chips, voids and other surface irregularities with one hundred percent Portland cement-based patching compound or cementitious fill.
- f. Apply cementitious surfacing over coating in areas to receive resilient and wood floor coverings to facilitate adhesion; apply to a thickness of 1/8 inch.

6. FILLING, LEVELING AND PATCHING

- A. Concrete slabs exhibiting high or low spots and indicated to receive resilient floor covering or soft floor covering, shall have surfaces repaired. High spots shall be honed, or ground with power-driven machines to required tolerances. Low spots shall be filled with latex underlayment, installed in strict accordance with manufacturer's written recommendations.
- B. Holes resulting from form ties or sleeve nuts shall be solidly packed, through exterior walls, by pressure grouting with cement grout, as specified. Grouted holes on exposed surfaces shall be screeded flush and finished to match adjoining surfaces.
- C. Cement Base: Cement base shall be of the height, thickness, and shape detailed. Base shall be reinforced with one inch mesh, 18 gage, zinc-coated wire fabric. Base finish mixture shall be one part Portland cement, 2 parts of fine aggregate and one part pea gravel. Colored cement base shall include a chemically inert mineral oxide pigment in the mix.

7. FINISHING

- A. Soda and Acid Wash: Concrete surfaces to receive plaster, paint or other finish, and which have been formed by oil coated forms, shall be scrubbed with a solution of 1-1/2 pounds of caustic soda to one gallon of water. Surfaces where smooth wood or waste molds have been furnished shall be scrubbed with a solution of 20 percent muriatic acid. Wash with clean water after scrubbing.
- B. Sacking: Exposed concrete curbs, walls, and other surfaces shall be sacked by an application of Portland cement grout, floated, and rubbed. Sacking shall not be performed until patching and filling of holes has been completed. Entire sacking operation for any continuous area shall be started and completed within the same day.
 - 1. Mix one part Portland cement and 1-1/2 parts fine sand with sufficient water to produce a grout having consistency of thick paint. Wet surface of concrete sufficiently to prevent absorption of water from grout. Apply grout uniformly with a brush or spray gun, then immediately float surface with a cork or other suitable float, scouring wall vigorously.
 - 2. While grout is still plastic, finish surface with a sponge-rubber float, removing excess grout. Allow surface to dry thoroughly, then rub vigorously with dry burlap to completely remove dried grout. No visible film or grout shall remain after rubbing with burlap.
- C. Sandblasting: Exterior concrete surfaces to receive stucco dash coat finish, where plywood or other smooth forms have been furnished, shall be uniformly sand blasted with sharp quartz sand under sufficient air pressure to remove dirt, form oil and other

foreign materials, and roughen surface to provide a proper bond. Such surfaces shall be thoroughly washed with clean water after sandblasting.

- D. Abrasive: Concrete stair treads, landings, ramps and steps on interior and exterior of buildings, and interior exposed concrete floors in shop buildings shall receive an abrasive finish.
- E. Floor Hardener: Exposed interior concrete floors throughout shall be treated with floor hardener.
 - 1. Protect adjacent surfaces. Clean surfaces to receive treatment in accordance with manufacturer's instructions, ensuring that all stains, oil, grease, form release agents, laitance, dust and dirt are removed prior to application.
 - 2. Apply hardener in accordance with manufacturer's instructions as soon as concrete is firm enough to work on after final troweling.
- F. Cement Grout and Dry-Pack Concrete: Cement grout shall be mixed at the Project site and shall be composed of one volume of Portland cement and 2-1/2 volumes of fine aggregate. Materials shall be mixed dry with sufficient water added to make mixture flow under its own weight. When grout is used as a dry pack concrete, add sufficient water to provide a stiff mixture, which can be molded into a sphere.
- G. Broom Finish: Exterior stair treads and landings shall be provided with a non-slip broom finish in addition to abrasive finish specified.
- H. Abrasive Stair Nosing: Nosing shall be installed according to manufacturers written recommendations.

8. EXPANSION AND CONSTRUCTION JOINTS

- A. Construction Joints: Details and proposed location of construction joints shall be as indicated on the Drawings, located to least impair strength of structure, in accordance with the following:
 - 1. Thoroughly clean contact surface by sand blasting entire surface not earlier than 5 days after initial placement.
 - 2. A mix containing same proportion of sand and cement provided in concrete plus a maximum of 50 percent of coarse aggregate shall be placed to a depth of at least one inch on horizontal joints. Vertical joints shall be wetted and coated with a neat cement grout immediately before placing of new concrete.
 - 3. Should contact surface become coated with earth, sawdust, or deleterious material of any kind after being cleaned, entire surface shall be re-cleaned before applying mix.
- B. Expansion Joints: Provide expansion joints where indicated in walks and exterior slabs. Space approximately 20 feet apart, unless otherwise indicated. Joints shall extend entirely through slab with joint filler in one piece for width of walk or slab. Joint filler shall be 3/8 inch thick, unless otherwise indicated.
- C. Tooled Joints: Slabs, walks and paving shall be marked into areas as indicated with markings made with a V-grooving tool. Marks shall be round-edged, free from burrs or

obstructions, with clean cut angles and shall be straight and true. Walks, if not indicated, shall be marked off into rectangles of not more than 12 square feet and shall have a center marking where more than 5 feet wide.

9. TESTING

A. Molded Cylinder Tests:

1. Inspector or testing lab personnel will prepare cylinders and perform slump tests. Samples for concrete strength shall be taken in accordance with ASTM C172. Each cylinder shall be dated, given a number, point in structure from which sample was obtained, mix design number, mix design strength and result of accompanying slump test noted.
2. Separate tests of molded concrete cylinders obtained at same place and time shall be made at age of three days, seven days, and 28 days. A strength test shall be the average of the compressive strength of two cylinders, obtained from the same sample of concrete and tested at 28 days or at test age designated for determination of f'_c .
3. Test cylinders shall be prepared at the Project site and stored in testing laboratory in accordance with ASTM C31, and tested in accordance with ASTM C39.

B. Core Test: At request of the ARCHITECT, cores of hardened concrete shall be cut from portions of hydrated structures for testing, in accordance with CBC and ASTM C42.

1. Provide 4-inch diameter cores at representative places throughout the structure as designated by the ARCHITECT.
2. In general, provide sufficient cores to represent concrete placed with at least one core for each 4,000 square feet of building area, and at least 3 cores total for each Project.
3. Where cores have been removed, fill voids with drypack, and patch the finish to match the adjacent existing surfaces.

C. Concrete Consistency: Measure consistency according to ASTM C143. Test twice each day or partial day's run of the mixer.

D. Adjustment of Mix: If the strength of any grade of concrete for any portion of Work, as indicated by molded test cylinders, falls below minimum 28 days compressive strength specified or indicated, adjust mix design for remaining portion of construction so that resulting concrete meets minimum strength requirements.

E. Air Content Testing: Measure in accordance with ASTM C173 or ASTM C231, for each composite sample taken in accordance to ASTM C172.

F. Defective Concrete:

1. Should strength of any grade of concrete, for any portion of Work indicated by tests of molded cylinders and core tests, fall below minimum 28 days strength specified or indicated, concrete will be deemed defective Work and shall be replaced or adequately strengthened in a manner acceptable to the ARCHITECT and DSA.
2. Concrete Work that is not formed as indicated, is not true within 1/250 of span, not true to intended alignment, not plumb or level where so intended, not true to

intended grades and levels, contains sawdust shavings, wood or embedded debris, or does not fully conform to Contract provisions, shall be deemed to be defective Work and shall be removed and replaced.

- G. Concrete for Equipment Pads, Mechanical and Electrical Work: Unless otherwise indicated, strength shall have a minimum $f'_c = 3,000$ psi. Exposed concrete shall be provided with a hand trowel finish with radius corners and edges. Form and place concrete where necessary as described in Section 03 1000 Concrete Forming and Accessories and reinforced as described in Section 03 2000 Concrete Reinforcing. Calcium chloride shall not be furnished in any concrete mix provided for the installation of underground electrical conduits. For concrete encasement of more than one conduit, furnish 3/4-inch maximum aggregate.

10. CLEAN UP

- A. Remove rubbish, debris and waste materials and legally dispose of off the Project site.

11. PROTECTION

- A. Protect the Work of this section until Substantial Completion.

END OF SECTION

DIVISION 04

MASONRY

SECTION 042200 – CONCRETE UNIT MASONRY

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Concrete Unit Masonry installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Concrete Masonry Units.
 - 2. Mortar and Grout.
 - 3. Reinforcing Steel.
 - 4. Control Joint Materials.
 - 5. Masonry Joint Reinforcement.
 - 6. Ties and Anchors.
 - 7. Embedded Flashing.
 - 8. Miscellaneous Masonry Accessories.
- C. Related Sections. The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 321323 – Site Concrete (for cast-in-place concrete footings).
- D. Products installed, but not furnished under this Section:
 - 1. Section 076200 – Sheet Metal Flashing and Trim.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. IBC – International Building Code.
 - 4. CBC – California Building Code.
- B. Material Specification Standards:
 - 1. ASTM C90 – Standard Specification for Load-Bearing Concrete Masonry Units.
 - 2. ASTM C270 – Standard Specification for Mortar for Unit Masonry.
 - 3. ASTM C476 – Standard Specification for Grout for Masonry.
- C. Material Testing Standards:
 - 1. ASTM C140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
 - 2. ASTM C780 – Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
 - 3. ASTM C1019 – Standard Test Method for Sampling and Testing Grout.

- D. Applicable Code: California Building Code, latest edition.
 - 1. The Code is hereby made a part of this Section and Masonry Work shall conform to applicable requirements therein except as otherwise specified herein or shown on the Contract Drawings. Nothing contained herein shall be construed as permitting Work that is contrary to Code requirements.
- E. Definitions:
 - 1. CMU – Concrete Masonry Unit.
 - 2. PCF – Pounds per Cubic Foot (measurement).
 - 3. PSI – Pounds per Square Inch (measurement).

3. SUBMITTALS

- A. General:
 - 1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 - 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 - 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
 - 1. Product/Material Data: Submit available product/material literature, mix designs, test reports, supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material:
 - a. Concrete Masonry Units.
 - b. Pre-Blended Mortar (Mix design indicating types and proportions of materials according to proportion specification of ASTM C270).
 - c. Conventional Grout (Mix design indicating types and proportions of materials according to proportion requirements of ASTM C476).
 - 2. Material Certificates, certifying compliance as specified:
 - a. Concrete Masonry Units.
 - b. Steel Reinforcing Bars.
 - c. Anchors, Ties, Fasteners, and Metal Accessories.
 - d. Preformed Control Joint Gaskets.
 - 3. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar installations.
 - 4. Scaled Shop Drawings: Provide enlarged scaled plans, elevations, sections, as required, for review by the Landscape Architect and Structural Engineer, indicating dimensioned fabrication and erection of CMU construction, including foundations, structural materials and components, joining materials, imbedments, cap units, or other items attached to or concealed in the Work.
 - 5. Refer to Section 034500 – Precast Architectural Concrete for products/materials specified under that Section that are required for Submittals under this Section. <<<VERIFY>>>
- C. Material Samples:
 - 1. To be reviewed as part of the Field-Constructed Mock-Ups.

- D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.

4. QUALITY ASSURANCE AND CONTROL

- A. Compressive Strength of Concrete Unit Masonry: Conform to CBC Code Sections 2105.3.2.1 and 2105.3.2.2. The 28-day minimum compressive strength (f'_m) shall be 1,500 PSI.
 - 1. Method of Testing: Compressive strength of masonry shall be determined based on strength of the Unit and type of Mortar specified (Unit Strength Method) per CBC Table 2105.2.2.1.2.
 - a. Concrete Masonry Units: Test per ASTM C140.
 - b. Mortar: Test per ASTM C780.
 - c. Grout: Test per ASTM C1019.
- B. Tests and inspections shall be performed by qualified individuals, engineering companies or testing laboratories who shall perform those tests and inspections specified below and such other tests and inspections as the Engineer or Owner may require to establish the acceptability of the Work. Testing and inspection services shall be retained by the Owner at his expense except that when tests or inspections reveal failure of materials to meet contract requirements, costs for subsequent tests and inspections will be deducted from moneys due to the Contractor.
- C. Installer Qualifications: Engage an experienced Installer with experience in successfully demonstrating the installation of Concrete Masonry Work similar in material, design, and extent to that indicated for this Project, with a record of successful performance, and with sufficient production capacity to produce required units without causing delay in the Work.
 - 1. Requirement: Valid California C-29 (Masonry Contractor) License.
- D. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
- E. Field-Constructed Mock-ups:
 - 1. Provide a complete fabricated sample panel (minimum 6'-0" long x height as indicated in the Contract Drawings) for all respective materials receiving finishing which is to be used as the basis for judging quality of workmanship throughout the project, as follows:
 - a. One side of the wall as a mock up.
 - b. Wall, complete:
 - a) Provide Wall, as required, per Contract Drawings.
 - 2. Prior to the installation of Work in this Section, erect Field-Constructed Mock-up to verify selections made under the Submittals Article to demonstrate aesthetic effects as well as qualities of materials and execution. Build Field-Constructed Mock-ups to comply with the following requirements, using materials indicated for final Unit of Work, including same base construction, joints, and contiguous Work as indicated.
 - 3. Locate Field-Constructed Mock-ups in the location and of the size indicated or, if not indicated, as directed by the Owner.
 - 4. Notify the Architect at least one (1) week in advance of the dates and times when the Field-Constructed Mock-up will be erected and ready for review.

5. Demonstrate the proposed range of aesthetic effects and workmanship in the Field-Constructed Mock-up that will be produced in final unit of Work.
6. When the Landscape Architect determines that a Field-Constructed Mock-up does not meet requirements, retain it for reference and construct another Field-Constructed Mock-up until it is accepted. Modify or correct Work as directed by Landscape Architect.
7. Obtain the Landscape Architect's acceptance of the Field-Constructed Mock-up, in writing, prior to the start of the final Unit of Work. An accepted Mock-up is a prerequisite to commencing Work under this Section.
8. Retain and maintain Field-Constructed Mock-ups during construction in an undisturbed condition. Accepted Field-Constructed Mock-ups shall be the standard for judging the completed Work under this Section.
9. Demolish and remove the Field-Constructed Mock-ups when directed by the Owner.
10. Accepted Field-Constructed Mock-ups may become part of the completed Work, if directed by the Landscape Architect.

5. DELIVERY, STORAGE AND HANDLING.

- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft or damage.
- B. Do not bring cementitious or other material to the site if it has become lumpy, caked, hardened or air slaked from absorption of moisture.
- C. Handle CMU's in manner to prevent chipping and breakage. Protect reinforcing steel from kinking and bending and from contamination with dirt, mud, oil and other foreign matter detrimental to bond.
- D. Deliver manufactured materials in original, unopened packages or containers with manufacturer's labels intact and legible.
- E. Store materials off ground and under cover, away from damp surfaces and inclement weather.
- F. Deliver and install materials so as to not delay Work, and install only after preparations for installation have been completed.

6. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work. Check actual locations of walls, adjoining finished surface grades, finished grades, pilasters, and other construction of Concrete Masonry Work by accurate field measurements before erection. Show recorded measurements on Shop Drawings.
- C. Perform installation operations only when weather is suitable in accordance with locally accepted practices:
 1. Cover top of unfinished masonry work to protect it from the weather.

2. Implement cold-weather procedures when ambient temperature falls below 40°F or the temperature of masonry units is below 40°F:
 - a. Wet or frozen Units shall not be laid.
 - b. Implement cold weather construction procedures in accordance with ACI 530.1.
 3. Implement hot-weather procedures when ambient temperature exceeds 100°F, or exceeds 90°F with a wind velocity greater than 8 mph:
 - a. Implement hot weather construction procedures in accordance with ACI 530.1.
 - D. Grades and Levels: Maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
 - E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. SUBSTITUTIONS

 - A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
 - B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
 - C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
 - D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. CONCRETE MASONRY UNITS
 - A. Concrete Masonry Units: Meet ASTM C90, two-cell, double-open end and bond beam units where indicated or required, made with medium-weight expanded-clay or shale aggregates.
 1. Size: Match existing on site.
 2. Color: Match existing on site.
 3. Type: Match existing on site.
 - a. Split Face.

2. MORTAR MATERIALS AND MORTAR MIXES

A. Mortar Materials:

1. Portland Cement: Meet ASTM C150 (CBC Standard 26-1), Type V.
2. Hydrated Lime: Meet ASTM C207 (CBC Standard 24-18), Type S.
3. Sand: Meet ASTM C144. For joints less than 1/4inch, use aggregate graded with one-hundred percent (100%) passing a No. 16 sieve.
4. Water: Per ASTM C94, from potable domestic source, and free from deleterious materials or impurities such as oils, acids, and organic matter which may be detrimental to mortar.
5. Bonding Agent: Meet ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
6. Admixtures:
 - a. Cold-Weather Admixture: Non-chloride, non-corrosive, accelerating admixture complying with ASTM C494, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a) *Accelguard 80*, Euclid Chemical Co.
 - b) *Morset, Grace*, W.R. Grace & Co., Construction Products Division.
 - c) Or equal, as approved by the Landscape Architect.
 - 2) Latex Additive (water emulsion) described below, serving as replacement for part of or all gaging water, of type specifically recommended by latex additive manufacturer for use with job-mixed Portland cement and aggregate and not containing a retarder.
 - 1) Latex Additive: Styrene butadiene rubber.
 - 2) Latex Additive: Acrylic resin.
7. Color Pigments: Where required, when integrally colored mortar and grout is used, use natural or synthetic iron oxides and chromium oxides, compounded for use in mortar mixes. not to exceed five-percent (5%) of the weight of masonry cement or ten-percent (10%) of the weight of Portland cement in the Mortar. Use only pigments with record of satisfactory performance in mortar.
 - a. Color: Color to match Unit Masonry. Submit Manufacturer's standard color range for selection by Architect.
 - b. Products & Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1) True Tone Mortar Colors, Davis Colors.
 - 2) Centurion Pigments, Lafarge Corporation.
 - 3) SGS Mortar Colors, Solomon Grind-Chem Services, Inc.
 - 4) Or equal, as approved by the Landscape Architect.
8. Blending: Mortar Materials shall be thoroughly blended as follows, with a total mixing time not less than ten (10) minutes:
 - a. Place approximately half of required water and sand into mixer while running.
 - b. Add cement and remainder of sand and water into mixer in that order and mix for a period of at least two (2) minutes.
 - c. Add lime and continue mixing as long as needed to secure a uniform mass.
 - d. Colored Pigmented Mortar: Select and proportion pigments with other ingredients to produce color required. Do not exceed pigment to cement ratio of 1 to 10, by weight.

B. Mortar Mix (pre-blended, pre-packaged factory mix):

1. General: Meet ASTM C270 and comply with CBC Standards 21-15, for Type S Mortar.
 - a. Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time,

- and other procedures needed to produce Mortar of uniform quality and with optimum performance characteristics.
2. Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated. Do not use calcium chloride.
 3. Color: Color to match Unit Masonry. Submit Manufacturer's standard color range for selection by Landscape Architect.
 4. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Mac High Absorbent Brick Mortar Polymer Modified (H.A.B. Poly) Type S*, Orco Blended Products, Inc.
 - b. *Spec Mix® Pre-Blended Dry Mortar Type S*, Premix Products of Southern California.
 - c. Or equal, as approved by the Landscape Architect.
 5. Special Veneer Bonding Mortar (for Brick Masonry Veneer Assemblies or Stone Masonry Veneer Assemblies):
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *VBM Poly300*, Orco Blended Products, Inc.
 - 2) *Spec Mix ® Stone Veneer Polymer Modified Mortar*, Premix Products of Southern California.
 - 3) Or equal, as approved by the Landscape Architect.
- C. Water: Per ASTM C 94, from potable domestic source, and free from deleterious materials or impurities such as oils, acids, and organic matter which may be detrimental to mortar or grout.

3. GROUT MATERIALS AND GROUT MIXES

- A. Grout Materials:
1. General: Materials for Grout shall be measured in suitable calibrated devices. After the addition of water, all materials shall be mixed for at least three (3) minutes in a drum type batch mixer. Mixing equipment and procedures shall produce Grout with the uniformity required for concrete by ASTM C94.
 2. Portland Cement: Meet ASTM C150 (CBC Standard 26-1), Type V.
 3. Hydrated Lime: Meet ASTM C207 (CBC Standard 24-18), Type S.
 4. Aggregate: Meet ASTM C404.
 5. Color: Color to match Unit Masonry. Submit Manufacturer's standard color range for selection by Landscape Architect.
 6. Water: Per ASTM C94, from potable domestic source, and free from deleterious materials or impurities such as oils, acids, and organic matter which may be detrimental to grout.
 7. Admixtures: When required, use only non-chloride based accelerators. Do not use antifreeze substances.
- B. Grout Mix (pre-packaged, pre-blended factory mix):
1. General: Meet ASTM C476 and comply with CBC, Section 2103.4.
 2. Optimum resistance to abrasion, compression and flexural strength, even after freeze/thaw cycles, good resistance to acids with pH>3, and free from cements that do not generate calcium hydroxide crystals which cause efflorescence during the hydration process.
 3. Minimum Compressive Strength: 2,000 PSI.
 4. Proportions: As specified in CBC, Table 21-B.

5. Color: Color to match Unit Masonry. Submit Manufacturer's standard color range for selection by Landscape Architect.

4. REINFORCEMENT AND METAL ACCESSORIES

- A. Metal Reinforcement and Accessories: Conform to ACI 530.1.
- B. Steel Reinforcing Bars: Meet ASTM A615.
- C. Masonry Joint Reinforcement: Meet ASTM A951. Maximum spacing of cross wires in ladder-type and points of connection of cross wires of truss-type joint reinforcement shall be 16 in.
- D. Anchors, Ties, and Accessories:
 1. Plate and Bent-Bar Anchors: Meet ASTM A36.
 2. Sheet-Metal Anchors and Ties: Meet ASTM A1008,
 3. Wire Mesh Ties: Meet ASTM A185.
 4. Wire Ties and Anchors: Meet ASTM A82.
 5. Headed Anchor Bolts: Meet ASTM A307, Grade A.
- E. Coatings for Corrosion Protection: Unless otherwise required, protect carbon steel joint reinforcement, ties, and anchors from corrosion by galvanizing or epoxy coating in conformance with the following minimums:
 1. Mill Galvanized Coatings:
 - a. Joint Reinforcement: Meet ASTM A641 (0.1 oz/ft²).
 - b. Sheet Metal Anchors and Ties: Meet ASTM A653 Coating Designation G60.
 2. Hot-Dipped Galvanized Coatings:
 - a. Joint Reinforcement, Wire Ties, and Wire Anchors: Meet ASTM A153 (1.50 oz/ft²).
 - b. Sheet Metal Anchors and Ties: Meet ASTM A153 Class B.
 3. Epoxy Coatings:
 - a. Joint Reinforcement: Meet ASTM A884 Class A, Type 1, ≥ 7 mils.
 - b. Wire Ties and Anchors: Meet ASTM A899 Class C, 20 mils.
 - c. Sheet Metal Anchors and Ties: 20 mils, per manufacturer's specification.

5. FLASHING MATERIALS

- A. Provide metal flashing in accordance with Section 076200 - Sheet Metal Flashing and Trim.

6. MISCELLANEOUS MASONRY ACCESSORIES

- A. Rubber Preformed Control-Joint Gaskets: Per ASTM D2000, Designation M2AA-805.
- B. PVC Preformed Control-Joint Gaskets: Per ASTM D2287, Type PVC 654-4.
- C. Fiber Joint Filler: Asphalt saturated fiber type conforming to ASTM D1751 for 1/2" thick, unless otherwise noted.

7. MASONRY CLEANER

- A. Use potable water and detergents to clean Masonry unless otherwise approved.

- B. Do not use acid or caustic solutions unless otherwise approved.

8. MIXING

- A. Mortar: Thoroughly blend Pre-packaged Masonry Mortar Mix per manufacturer's recommendations.
- B. Grout: Thoroughly blend Pre-packaged Masonry Grout Mix to a consistency that has a slump between 8 and 11 in., per manufacturer's recommendations.

9. FABRICATION

- A. Fabricate Reinforcement per ACI 530.1.

3.EXECUTION

1. EXAMINATION

- A. Prior to the start of Masonry installation, verify all conditions pertinent to the performance of work in this Section are acceptable.
 - 1. Verify foundations are constructed within a level alignment tolerance of $\pm 1/2$ in.
 - 2. Verify that reinforcing dowels are positioned in accordance with Project Drawings.
- B. Masonry work shall not proceed until unsatisfactory conditions have been corrected or approved by the Landscape Architect.

2. PREPARATION

- A. Clean reinforcement and shanks of anchor bolts by removing mud, oil, or other materials that will adversely affect bond to mortar or grout.
 - 1. Reinforcement with rust and/or mill scale is acceptable provided attributes of a cleaned sample are in accordance with the applicable ASTM specification.
- B. Prior to laying masonry, remove laitance, loose aggregate, and any other material that would prevent mortar from bonding to the foundation.
- C. Do not wet units before laying, unless otherwise required. Wet cutting is permitted.
- D. Cut units as required to fit; use motor-driven masonry saw. Install cut units with cut surfaces concealed as much as possible.

3. INSTALLATION

- A. Select and arrange units for exposed masonry to produce a uniform blend of colors and textures.
 - 1. Mix units from several pallets or cubes as they are placed.
- B. Comply with construction tolerances in ACI 530.1.

- C. Construct grout spaces free of mortar dropping, debris, and any material deleterious to grouting.
 - D. Construct cleanouts in the bottom course of Masonry for each grout pour when the grout pour height exceeds 5 ft. 4in.
 - 1. Hollow-Unit Masonry: Create cleanout by cutting off entire face shell of the CMU. Replace face shell after inspection and before grouting.
 - 2. Solid-unit Masonry: Create cleanout by leaving out every other Unit. Install Unit after inspection and before grouting.
 - 3. Brace cleanout closure to resist grout pressure.
 - 4. For partially grouted masonry, construct cleanouts at bottom of each cell to be grouted.
 - 5. For solid-grouted masonry, space cleanouts horizontally a maximum 32 in. on-center.
 - E. All masonry shall be laid true, level, plumb, and in accordance with the Contract Drawings.
 - F. Ensure all vertical cells to be grouted are aligned and unobstructed openings for grout are provided in accordance with the Contract Drawings.
 - G. Exposed masonry shall be laid in running bond unless otherwise indicated in the Contract Drawings.
 - H. Concealed masonry with shall be laid in running bond unless otherwise indicated.
 - I. Brace masonry during construction to assure stability. Design, provide, and install bracing.
4. MORTAR BEDDING AND JOINTING
- A. Place mortar in accordance with ACI 530.1.
 - B. Initial bed joint shall not be less than $\frac{1}{4}$ inch nor more than $\frac{3}{4}$ inch.
 - C. All head and bed joints, except as in 3.4 B., shall be a nominal $\frac{3}{8}$ in. thick, unless otherwise required.
 - D. Lay hollow units with head and bed joints filled with mortar for the thickness of the face shell.
 - E. Lay solid units with full head and bed joints. Do not fill head joints by slushing with mortar. Bed joints shall not be furrowed deep enough to produce voids.
 - F. Remove mortar protrusions extending $\frac{1}{2}$ in. or more into cells to be grouted.
 - G. Fully mortar webs in all courses of piers, columns and pilasters, in the starting course on foundations, and when necessary to confine grout.
 - H. All mortar joints on exposed walls shall be concave, unless otherwise indicated, and struck to produce a dense, slightly concave surface well bonded to the surface of the masonry unit.
 - I. Remove and re-lay in fresh mortar any unit that has been disturbed to the extent the initial bond is broken.
5. EMBEDDED ITEMS AND ACCESSORIES
- A. Construct control joints as detailed in the drawings as masonry progresses.

1. Install preformed control-joint gaskets designed to fit standard sash block.
 - B. Construct chases as masonry units are laid.
 - C. Install pipes and conduits passing horizontally through nonbearing masonry partitions as indicated.
 - D. Place pipes and conduits passing horizontally through piers, pilasters, or columns as indicated.
 - E. Place horizontal pipes and conduits in and parallel to plane of walls.
 - F. Install and secure connectors, flashing, weep holes, weep vents, nailing blocks, and other accessories as required.
6. INSTALLATION OF REINFORCING STEEL, WALL TIES, AND ANCHORS
- A. Install reinforcing steel, wall ties, and anchors in accordance with ACI 530.1.
 - B. Place Reinforcement as detailed on the Contract Drawings.
 1. Support and fasten reinforcement to prevent displacement beyond specified tolerances during construction and grouting operations.
 2. Maintain clear distances between reinforcement and any interior face of masonry unit or formed surface, but not less than $\frac{1}{4}$ in. for fine grout, or $\frac{1}{2}$ in. for coarse grout.
 3. Completely embed reinforcing bars in grout.
 4. Place reinforcing bars maintaining minimum cover of:
 - a. Where masonry is exposed to weather, 2 in. for bars larger than No. 5, $1\frac{1}{2}$ in. for No. 5 or smaller.
 - b. Where masonry is not exposed to weather, $1\frac{1}{2}$ in.
 5. Embed joint reinforcement with minimum $\frac{5}{8}$ inch cover to faces exposed to weather or earth, and $\frac{1}{2}$ inch elsewhere.
 - a. Provide minimum 6-in. lap splices and ensure that all ends of longitudinal wires are embedded in mortar at laps.
 6. Tolerances for placement of reinforcing bars in walls and flexural elements shall be $\pm \frac{1}{2}$ in. when the distance from the centerline of reinforcing bars to the opposite face of masonry, d , is equal to 8 in. or less, ± 1 in. for d equal to 24 in. or less but greater than 8 in., and $\pm 1\frac{1}{4}$ in. for d greater than 24 in.
 7. Foundation dowels that interfere with unit webs are permitted to be bent to a maximum of 1 in. horizontally for every 6 in. of vertical height.
 - C. Install wall ties as detailed on the Contract Drawings, and in accordance with ACI 530.1.
 - D. Install anchor bolts ties as detailed on the Contract Drawings, and in accordance with ACI 530.1.
 1. Embed headed and bent-bar anchor bolts in grout. Anchor bolts of $\frac{1}{4}$ in. or less may be placed in mortar bed joints at least $\frac{1}{2}$ in. in specified thickness.
 2. Maintain clear distance between anchor bolts and any face of masonry unit or formed surface of at least $\frac{1}{4}$ in. when using fine grout, and of at least $\frac{1}{2}$ in. when using coarse grout.
 3. Maintain a clear distance between parallel anchor bolts not less the diameter of the anchor bolt, nor less than 1 in.
7. GROUTING

- A. Solid fill all cell voids with Grout.
- B. Grout spaces shall not be wet at the time Grout is placed.
- C. Spaces to be filled with Grout shall be free from debris, mortar, etc., before filling.
- D. Grout shall not be placed by high lift process until mortar in joints has set for 24 hours.
- E. High-lift Grout shall be poured in maximum lifts of four feet (4'-0"). At cessation of each lift, the Grout in this lift shall be vibrated with a 3/4" flexible cable vibrator for the full height of the lift. Vibrator shall be placed in cells not to exceed 16" centers (in plan). When top of wall is reached, alternately "top" and vibrate to complete the pour to top of wall. Succeeding lifts of Grout shall be placed following an appropriate lapse of time for grout settlement and absorption of excess moisture.
- F. Place high-lift grout using adequate grout pumps.
- G. For such time as may be required immediately following grouting, keep walls flushed down with a pressure stream of clear water to completely remove laitance from exposed faces.

8. POINTING, AND CLEANING

- A. Point and tool holes in mortar joints to produce a uniform, tight joint.
- B. During construction, minimize any mortar or grout stains on the wall. Immediately remove any staining or soiling that occurs.
 - 1. For precision or textured units, except as noted below, clean masonry by dry brushing before tooling joints.
 - 2. For burnished, glazed, or pre-finished concrete masonry units, immediately remove any green mortar smears or soiling with a damp sponge.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry surfaces of stains, efflorescence, mortar or grout droppings, and debris.
 - 1. Use appropriate masonry cleaner as tested on the sample panel and as approved by the Landscape Architect, strictly following manufacturer's recommendations.
 - 2. Do not use acids.
- D. At completion of Work, remove all scaffolding and equipment used during construction, and remove all debris, refuse, and surplus masonry material from the site.
 - 1. Comply with Construction Waste Management plan.

END OF SECTION

SECTION 044200 – DIMENSIONAL STONE CLADDING SUPPORT SYSTEM

1.0 GENERAL

1.1 SUMMARY

- A. Section Includes: Engineered, aluminum rainscreen support framing at exterior cavity walls.

1.2 REFERENCES

1.3 SYSTEM DESCRIPTION

- A. Structural Design: Provide engineered design capable of withstanding combined effects of stresses from dead loads, wind loads, normal thermal movement, and other anticipated stresses without evidence of permanent defects or failure.
 - 1. Wind Load: Uniform pressure (velocity pressure) as indicated on Structural Drawings, acting inward or outward.
 - 2. Dead Loads: Design for loading to accommodate support of cladding systems specified by related sections and shown on Drawings and as required by applicable building code.
 - 3. Seismic Loads: Design and size components to withstand seismic loads and sway displacement.
 - 4. Design all components to deflect, perpendicular to the plane of the wall, no more than $L/360$ the span, under design wind loading.
- B. Thermal Expansion and Contraction: Design for movement due to cyclic day and night temperatures to not exceed safety factors for fasteners, joints, seals, and components.
- C. Rain Screen Design: Design ventilating system assembly to accommodate movement of air into and out of the assembly.
- D. Cladding Accommodation: Design framing support assembly to maintain dimensions to face of cladding materials indicated on Drawings. Design framing supports configuration, size, spacing, and make adjustments as needed to accommodate support for each cladding type, including:
- E. Stone: Coordinate with Section 044200 and/or Section 074200 for design of stone support system; stone fabrication requirements.

1.4 SUBMITTALS

- A. Make submittals in accordance with Section 013300.
- B. Product Data: Include the following.
 - 1. Descriptive product literature describing assembly design, performance, and characteristics.
 - 3. Metal finishes, accessories, and components.
- C. Shop Drawings:
 - 1. Plans, elevations, openings, details, fasteners, connectors and anchorage devices, and attachments as needed for project execution.
 - 2. Indicate clearances between cladding panels, finishes, weeping, provisions, and opening details.
 - 3. Interface of cladding assembly with adjacent construction.
 - 4. In accordance with stamped and signed engineering letter of compliance.
- D. Informational Submittals:
 - 1. Design Calculations:
 - a. Comprehensive analysis of design loads, including dead loads, live loads and wind loads

- b. Design shall be sealed by the designing engineer.
 - c. Test Data: Independent test results or engineered analysis for performance signed by independent agency representative.
- 2. Manufacturer's Instructions: Include installation instructions, clearances, special procedures.
- E. Warranty Draft: Concurrent with initial product data submittal, submit draft of manufacturer's warranty for Architect's review of terms. Draft shall include all specified exceptions and inclusions.

1.5 QUALITY ASSURANCE

- A. Work of this Section is subject to testing and inspection as specified in Section 014500.
- B. Manufacturer Qualifications:
 - 1. Maintain locally available technical product representation available to meet at project site as needed for meetings and inspections of work.
- C. Installer Qualifications:
 - 1. Employ full-time on-site superintendent or foreman to overseeing installation during work of this Section.
 - 2. Able to show successfully completed projects of equivalent scope and quality upon request by Architect.
- D. Structural Design:
 - 1. Support systems shall be designed by a professional structural engineer licensed in the state of the project
 - 2. Stone Veneer:
 - a. Comply with the applicable requirements of ASTM C1242 for design of masonry support system.
 - b. Seismic Requirements: Design the anchored masonry veneer system to conform to the seismic requirements of the local Building Code.
- E. Mock-ups:
 - 1. In locations as directed by the Architect, construct mock-up of complete support system for each proposed cladding material.
 - 2. Provide as required to illustrate substrate, air barrier, insulation, framing, flashing, and treatments at fenestrations, corners, and transitions.
 - 3. Verify mock-ups as conforming to manufacturer's instructions and provisions of Contract Documents.
 - 4. Do not begin work of this Section until after inspection by manufacturer's representative is complete and mock-up has been accepted in writing by Architect.
 - 5. Protect and maintain accepted mock-up as standard of quality for work of this Section.
 - 6. Accepted mock-ups may be incorporated into the work of this Section.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Ordering: Conform to manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Store and handle to keep clean, dry, and protected from damage due to weather and construction activities.

1.7 WARRANTY

- A. Manufacturer's Warranty: 20-year limited manufacturer materials warranty, terms available at request.

2, PRODUCTS

2.1 MANUFACTURER

- A. Gridworx by Precision Wall Systems.
10980 Alder Circle, Dallas, TX 75239
214.774.4502

2.2 SUPPORT SYSTEMS

- A. Proprietary Design/Build panel, modified curtain wall cladding system for project use which includes all materials required to provide a completed system including, but not limited to the following

- 1. Gridworx Cladding System- UXF

2.3 MATERIALS

- B. Gridworx "UXF" Extruded Aluminum Cladding System; Floating Mount Anchors:
 - 1. Material: Alloy – 6005A-T61 mill finish; optional black anodized finish of AA M12C22A21 meeting the standard of AAMA 611-98

- C. Gridworx "UXF" Substrate channels extruded in J configurations and align with engagement anchors. All channels are extruded in twelve-foot (12') lengths and cut to length in the field.

- D. Gridworx Discrete "Ultra XL" Panel Clips are spaced on back of panel at dead load and wind load locations as determined by curtainwall engineer and attached using Gridworx lock washer and undercut anchor.

- E. Screw Fasteners:

- 1. Concrete

- a. Hilti KH-EZ SS316 Screw Anchor. 1/4"x2-1/2" MC #3675739

- F. Undercut anchors:

- A. Type 31 Stainless Steel Anchors. 1 1/4" length.

- G. Shims

- 1. Full bearing hi-impact resistant plastic of 3" vertical or greater.

3. EXECUTION

3.1 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence. Notify the Architect in writing of conditions detrimental to the proper and timely completion of the work.
- B. Do not begin installation until all unsatisfactory conditions are resolved. Beginning work constitutes acceptance of site conditions and responsibility for defective installation caused by prior observable conditions.

3.2 PREPARATION

- A. Review areas of potential interference and conflicts, and coordinate layout and support provisions for interfacing work.
- B. Adjust and perform work as necessary for plumb and true alignments.

3.3 INSTALLATION

- A. LIST INSTALLATION PROCEDURE

3.4 ERECTION TOLERANCES

- A. Maximum Framing Member Variation from True Position: ____ inch.
- B. Maximum Framing Member Variation from Plane:
 - 1. Individual Framing Members: Do not exceed ____ inch in 10 foot.
 - 2. Accumulative Over-all Variation for Wall and Floor System: Do not exceed ____ inch.

3.5 FIELD QUALITY CONTROL

- A. Manufacturer's Field Technical Service: Make intermittent and final inspection to verify installation in conformance to manufacturer instructions and suitable as framing assembly for subsequent metal panels, acrylic plastering, and other cladding installations.
 - 1. Confirm snug tight and fastener sizing.
 - 2. Confirm framing members installed in correct orientation.

3.6 ADJUSTING

- A. Inspect and adjust after installation. Replace or repair defective work.
- B. Adjust, and reconfigure as necessary to accommodate cladding systems for installations over work of this Section. Do not reuse pre-drilled holes unless fastener size is increased.

END OF SECTION

SECTION 044200 – EXTERIOR DIMENSION STONE

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Embedded Exterior Dimension Stone installation, as shown on the Contract Drawings, and as specified herein this Section.
 - 1. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - a. Dimension Stone, anchored to cast-in-place concrete backup.
- B. Related Sections contain requirements that relate to Work in this Section:
 - 1. Section 04 42 00 – Dimension Stone Cladding Support System
 - 2. Section 071416 – Cold Fluid-Applied Waterproofing.
 - 3. Section 321323 – Site Concrete.
 - 4. Section 329113 – Soil Preparation.
 - 5. Section 321400 – Unit Paving

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ANSI – American National Standards Institute.
 - 2. ASCE – American Society of Civil Engineers.
 - 3. ASTM – American Society for Testing and Materials.
 - 4. IBC – International Building Code.
 - 5. CBC – California Building Code.
- B. Material Specification and Testing Standards:
 - 1. ASTM A123 – Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings of Iron and Steel Products.
 - 2. ASTM C97 – Test Methods for Absorption and Sulk Specific Gravity of Dimension Stone.
 - 3. ASTM C119 – Terminology Relating to Dimension Stone.
 - 4. ASTM C170 – Test Method for Compressive Strength of Dimension Stone.

3. PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide Embedded Exterior Dimension Stone capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
- B. Seismic Performance: Provide Embedded Exterior Dimension Stone capable of withstanding the effects of earthquake motions determined according to the building code in effect for this Project or ASCE 7, "Minimum Design Loads for Buildings and Other Structures," Section 9, "Earthquake Loads," whichever is more stringent.

- C. Thermal Movements: Provide Embedded Exterior Dimension Stone that allows for thermal movements resulting from the following maximum change [range] in ambient and surface temperatures by preventing displacement of stone, opening of joints, over stressing of components, failure of joint sealants and connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change [Range]: 120 deg F, ambient; 180 deg F, material surfaces.
- D. Design stone anchorages to withstand loads indicated without exceeding allowable working stress of stone determined by dividing stone's average ultimate strength, as established by testing, by the following safety factors:
 - 1. Safety Factors for Marble: 5 for uniform loads and 10 for concentrated loads.
- E. Design stone supports and anchors, including panel framing systems, metal-grid systems, and connections to building structure, to withstand loads indicated without exceeding allowable stresses established by the following:
 - 1. For Structural Steel: AISC S335, "Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary."
 - 2. For Cold-Formed Steel: AISI SG-673, Part I, "Specification for the Design of Cold-Formed Steel Structural Members."
 - 3. For Cast-in-Place and Post-Installed Anchors in Concrete: One-fourth of anchor's tested capacity when installed in concrete with compressive strength indicated.
- F. Limit deflection in each fabricated panel assembly caused by indicated loads and thermal movements, acting singly or in combination with one another.
- G. Control of Corrosion and Staining: Prevent galvanic and other forms of corrosion as well as staining by isolating metals and other materials from direct contact with incompatible materials. Use materials that are nonstaining to exposed surfaces of stone and joint materials.

4. SUBMITTALS

- A. General:
 - 1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 - 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 - 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
 - 1. Product/Material Data: For each variety of stone, stone accessory, and other manufactured products specified.
 - a. For stone varieties proposed for use on Project, include data on physical properties required by referenced ASTM standards.
 - 2. Qualification Data: For firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

3. Shop Drawings: Show details of fabrication and installation of Embedded Exterior Dimension Stone, including dimensions and profiles of stone units; arrangement and details of jointing, supporting, anchoring, and bonding Embedded Exterior Dimension Stone; and details showing relationship with, attachment to, and reception of related Work.
 - a. Show locations and details of sealant joints both within Embedded Exterior Dimension Stone and between dimension stone and other construction.
 - b. For installed stone anchorages and supports indicated to comply with certain design loads and deflection limits, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - C. Material Samples:
 1. Stone Samples for Verification: (2) Sets for each color, grade, finish, and variety of stone required; not less than twelve-inches (12") square. Include two (2) or more samples in each set showing the full range of variations in appearance characteristics expected in completed Work.
 2. Submit (1) 4' wide x 9' high panel mock up with sandblasted letters in selected material sample to be confirmed by the Architect.
 3. Sealant Samples for Initial Selection: Manufacturer's standard bead samples of actual products showing the full range of colors available for each type of sealant exposed to view.
 - D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
 - E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
5. QUALITY ASSURANCE AND CONTROL
- A. Installer Qualifications: Engage an experienced installer who has completed Embedded Exterior Dimension Stone similar in material, design, and extent to that indicated for Project that has resulted in construction with a record of successful in-service performance.
 1. Installer shall assume responsibility for engineering, fabricating, and installing dimension stone cladding system.
 2. Engineering Responsibility: Engage a qualified professional engineer to prepare or supervise the preparation of data for Embedded Exterior Dimension Stone, including Shop Drawings and comprehensive engineering analysis that shows the system's compliance with specified requirements.
 - B. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
 - C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties and to cut and finish material without delaying the Work.
 1. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.

- D. Source Limitations for Mortar and Grout Materials: Obtain mortar ingredients of uniform quality for each cementitious component from a single manufacturer and each aggregate from one source or producer.
- E. Source Limitations for Other Materials: Obtain each type of stone accessory and other material from a single manufacturer for each product.
- F. Flexural Strength Tests: Additional flexural strength tests per ASTM C880 will be performed on specimens representative of minimum thickness and finish of installed stone, in both wet and dry conditions. Results of these additional tests will be used to determine compliance with Project requirements.
- G. Anchorage Tests: Specimens representative of minimum thickness and finish of installed stone with anchors attached will be tested to failure to verify capacity of anchors.
- H. Mockups: Before installing Embedded Exterior Dimension Stone, construct sample panel to verify selections made under Sample submittal and to demonstrate aesthetic effects and qualities of materials and execution. Build Mockups to comply with the following requirements, using materials indicated for completed Work.
 - 1. Locate mockups in the locations indicated or, if not indicated, as directed by Landscape Architect.
 - 2. Build mockups for the following kinds of Embedded Exterior Dimension Stone:
 - a. Typical masonry wall with stone cladding, approximately 4' wide by 9' high panel mock up with sandblasted letters on cast in place concrete wall mock up with support system and cold fluid applied waterproofing with sample of wall camp and dowelled installation.
 - b. Embedded Exterior Dimension Stone corresponding to area indicated on Drawings, showing typical components, connections, attachments to building structure, and methods of installation.
 - 3. Maintain Mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - a. Approval of Mockups does not constitute approval of deviations from Contract Documents contained in Mockups, unless such deviations are specifically approved by Landscape Architect in writing.
 - b. When directed, demolish and remove mockups from Project site.

6. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in undamaged condition.
 - 1. Deliver sealants to Project site in original unopened containers labeled with manufacturer's name, product name and designation, color, expiration period, pot life, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle stone and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping, or other causes.
 - 1. Lift with wide-belt slings; do not use wire rope or ropes that might cause staining. Move stone, if required, using dollies with cushioned wood supports.
 - 2. Store stone on wood skids or pallets with nonstaining, waterproof covers. Arrange to distribute weight evenly and to prevent damage to stone. Ventilate under covers to prevent condensation.
 - 3. Store cementitious materials off ground, under cover, and in dry location.

7. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work. Check actual locations of walls, adjoining finished surface grades, finished grades, and other construction by accurate field measurements before erection. Show recorded measurements on Shop Drawings.
- C. Perform installation operations only when weather is suitable in accordance with locally accepted practices:
- D. Grades and Levels: Maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

2.PRODUCTS

1. STONE SOURCES

- A. Stone Per Contract Drawings: Cold Spring, Cold Spring, MN - contact LeAnne Black- email: lblack@coldspringusa.com, tel: 480.330.6972
- B. Stone Per Contract Drawings: Quarra Stone, Sun Prairie, WI : contact Steven Rousseau- email: Steven@quarrastone.com, tel 540.522.9263
- C. Stone Per Contract Drawings : Or Equivalent Quality Supplier to be approved by the Architect.

2. STONE MATERIAL

- A. Memorial Wall Panels with Sandblasted Names (M-6): Black Granite Stone with polished finish. Wall Panel Thickness: 1-5/8". Wall Top Cap: 2" thick. Wall End Panel: 3" thick. Sandblasted names using 10 ml template. Stone stain used is specifically formulated for stone applications, color to be determined by the Architect.
 - 1. Cold Spring Stone: Raven Noir, Cold Springs Black, Academy Black
 - 2. Quarra Stone: Volga Black Premier- Black granite to have small grain size and uniform black color appearance with light color

variation. Min. density of 185 lbs/ft³. Min Compressive Strength of 32,000 Psi

3. Or Equivalent to be approved by the Architect.

- B. Memorial Information Wall Panels (M-7): Black Granite Stone with Diamond 8 or honed finish. Stone to be produced per the contract documents. Title letters to be sand blasted and additional fabrication using Rhino version 8 digitally modeled format software. To ensure accuracy, stone letters to be milled using 5-axis CNC equipment. Wall Panel Thickness: 1-5/8". Wall Top Cap: 2" thick. Wall End Panel: 3" thick. Stone color(s) and finishes as selected and approved by the Architect. Stone stain used is specifically formulated for stone application in color to be determined by Architect.

4. Cold Spring: Raven Noir, Cold Springs Black, Academy Black

5. Quarra Stone: Volga Black - Black granite to have small grain size and uniform black color appearance with light color variation. Min. density of 185 lbs/ft³. Min Compressive Strength of 32,000 Psi

6. Or Equivalent to be approved by the Architect.

3. STONE PAVING - REFER TO Section 321400 Unit Paving

4. STONE BENCH BLOCKS

- A. Match referee samples, as acquired by the Architect, for variety, color, finish, and other stone characteristics relating to aesthetic effects.
- B. Provide stone from a single quarry for each variety of stone required.
1. Provide matched blocks extracted from a single bed of quarry stratum unless stone from blocks randomly selected for aesthetic effect is acceptable to Architect.
- C. Quarry stone in a manner to ensure as-quarried block orientations yield finished stone with required characteristics.
- D. Solid Stone Bench Material (M-10): Black Granite Stone with textured finish. Stone to be produced per the contract documents. Include skate board deterrent milled grooves per Contract Documents. Stone color(s) and finishes as selected and approved by the Architect.

7. Cold Spring Stone: Raven Noir, Cold Springs Black, Academy Black with textured finish.

8. Quarra Stone: Volga Black Bright Blast Finish - black granite to have small grain size and uniform black color appearance with light color variation. Min. density of 185 lbs/ft³. Min Compressive Strength of 32,000 Psi.

9. Or Equivalent to be approved by the Architect

5. CONCRETE SETTING MATERIALS

- A. Refer to Section 321323 – Site Concrete, for requirements.

6. ANCHORS AND SUPPORT ANGLES

- A. Provide Anchors and Support Angles of type and size required to support Embedded Exterior Dimension Stone and to sustain imposed loads. Fabricate from the following metals for conditions indicated:
 - 1. Stainless Steel or Black anodized aluminum: ASTM A666, Type 316, temper as required to support loads imposed without exceeding allowable design stresses.
 - a. Fasteners for Stainless-Steel Anchors and Support Angles: Annealed stainless-steel bolts, nuts, and washers of same alloy as anchors. ASTM F593 for bolts and ASTM F594 for nuts.

7. ELASTOMERIC SEALANT (IF USED)

- A. Sealant Products: Provide manufacturer's standard chemically curing, elastomeric sealants that are compatible with joint fillers, joint substrates, and other related materials and that comply with requirements of Division 7 Section "Joint Sealants" for products corresponding to those indicated below:
- B. Color: Provide color of exposed sealants to comply with the following requirement:
 - 1. Match color of stone.

8. COLD FLUID-APPLIED WATERPROOF MEMBRANE

- A. Refer to Section 071416– Cold Fluid-Applied Waterproofing, for requirements.

9. STONE FABRICATION

- A. General: Fabricate Embedded Exterior Dimension Stone in sizes and shapes required to comply with requirements indicated, including details on Drawings and Shop Drawings.
- B. Cut and drill sinkages and holes in stone for anchors, fasteners, reinforcement, supports, or lifting devices as indicated or needed to set stone securely in place; shape beds to fit supports.
- C. Cut stone to produce pieces of thickness, size, and shape indicated and to comply with fabrication and construction tolerances recommended by applicable stone association or, if none, by stone source, for faces, edges, beds, and backs.
 - 1. Thickness of Embedded Exterior Dimension Stone: Provide thickness indicated, but not less than the following:
 - a. Refer to Contract Drawings.
 - 2. Control depth of stone and back check to maintain minimum clearances indicated between backs of stone units and surfaces or projections of structural members, back-up walls, and other work behind stone.
 - 3. Dress joints [bed and vertical] straight and at right angle to face, unless otherwise indicated.
 - 4. Quirk-miter corners, unless otherwise indicated; provide for cramp anchorage in top and bottom bed joints of corner pieces.

5. Cut stone to produce joints of uniform width and in locations indicated.
 - a. Joint Width: 1/4 inch.
 6. Clean sawn backs of stone to remove rust stains and iron particles.
- D. Contiguous Work: Provide chases, reveals, reglets, openings, and similar features as required to accommodate contiguous Work.
- E. Carefully inspect finished stone units at fabrication plant for compliance with requirements for appearance, material, and fabrication. Replace defective units.
1. Grade and mark stone for overall uniform appearance when assembled in place. Natural variations in appearance are acceptable if installed stone units match range of colors and other appearance characteristics represented in approved samples and mockups.
10. FABRICATION OF REINFORCING
- A. Fabricate Reinforcement per ACI 530.1

3.EXECUTION

1. EXAMINATION
- A. Examine surfaces to receive Embedded Exterior Dimension Stone and conditions under which Embedded Exterior Dimension Stone will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of Embedded Exterior Dimension Stone.
1. Do not proceed with installation until unsatisfactory conditions have been corrected.
2. PREPARATION
- A. Protect Embedded Exterior Dimension Stone during erection as follows:
1. Cover tops of walls with nonstaining, waterproof sheeting at end of each day's Work. Cover partially completed structures when Work is not in progress. Extend cover a minimum of 24 inches down both sides and hold securely in place.
 2. Prevent staining of stone from mortar, grout, sealants, and other sources. Immediately remove such materials without damaging Embedded Exterior Dimension Stone.
- B. Clean stone surfaces that have become dirty or stained by removing soil, stains, and foreign materials before setting. Clean stone by thoroughly scrubbing with fiber brushes and then drenching with clear water. Use only mild cleaning compounds that contain no caustic or harsh materials or abrasives.
3. SETTING DIMENSION STONE CLADDING, GENERAL
- A. Execute dimension stone cladding installation by skilled mechanics.
- B. Contiguous Work: Provide openings as required to accommodate contiguous work.
- C. Set stone to comply with requirements indicated on Drawings and Shop Drawings. Install anchors, supports, fasteners, and other attachments indicated or necessary to secure dimension

stone cladding in place. Shim and adjust anchors, supports, and accessories to set stone accurately in locations indicated with uniform joints of widths indicated and with edges and faces aligned according to established relationships and indicated tolerances.

4. CONSTRUCTION TOLERANCES

- A. Variation from Plumb: For vertical lines and surfaces of walls, do not exceed 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch in 40 feet or more. For external corners, corners and jambs within 20 feet of an entrance, expansion joints, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch in 40 feet or more.
- B. Variation from Level: For lintels, sills, water tables, parapets, horizontal bands, horizontal grooves, and other conspicuous lines, do not exceed 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.
- C. Variation of Linear Building Line: For position shown in plan and related portion of walls and partitions, do not exceed 1/4 inch in 20 feet or 1/2 inch in 40 feet or more.
- D. Variation in Cross-Sectional Dimensions: For thickness of walls from dimensions indicated, do not exceed plus or minus 1/4 inch.
- E. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch in 36 inches or one-fourth of nominal joint width, whichever is less.
- F. Variation in Plane between Adjacent Panels [Lipping]: Do not exceed 1/16-inch difference between planes of adjacent units.

5. PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to Fabricator and Installer, that ensure Embedded Exterior Dimension Stone is without damage or deterioration at the time of Substantial Completion.

END OF SECTION

DIVISION 05

METALS

SECTION 057000 – DECORATIVE METAL

PART 1 - GENERAL

1. RELATED DOCUMENTS

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

2. SECTION INCLUDES

- A. Shop-fabricated decorative metal items.

3. COORDINATION

- A. Coordinate installation of anchorages for decorative metal items. 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.

4. ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, including finishing materials.
- B. Shop Drawings: For decorative metal. Include plans, elevations, component details, and attachments to other work. Indicate materials and profiles of each decorative metal member, fittings, joinery, finishes, fasteners, anchorages, and accessory items.
 - 1. Provide templates for anchors and bolts specified for installation under other Sections.
 - 2. Submit detail fabrication of woven wire cloth. Include plans, elevations, sections and details of components and their connections. Show mounting system and accessory items.
 - 3. Provide plans, elevations, sections, component details, mounting systems and accessory items, and attachments to other work. Indicate materials and profiles of each ornamental metal screen and frame members, fittings, finishes, fasteners, anchorages, and accessory items.
 - 4. Incorporate on-site measurements into shop drawings of tensioned mesh panels.
- C. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of linear shapes.
 - 2. Submit for finishes and characteristics of the specified wire cloth design.
 - 3. Submit production sample of each type of wire mesh.

7. INFORMATIONAL SUBMITTALS

- A. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.
- B. Certification: Submit chemical and physical wire certification as requested.
- C. Qualification Data: For Installer and fabricator.
- D. Warranty: Sample of special warranty.

8. CLOSEOUT SUBMITTALS

- A. Warranty: Executed special warranty specified in this Section.

9. QUALITY ASSURANCE

- A. Installer Qualifications: At least 5 years of in field performance. Arrange for the installation of ornamental metal screens and substructure specified in this section.
- B. Fabricator Qualifications: A firm experienced in producing decorative metal similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in the State of California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of handrails and railings that are similar to those indicated for this Project in material, design, and extent.
- D. Engineering Services:
1. Shop Drawings: Submit detail fabrication of woven wire cloth. Include plans, elevations, sections and details of components and their connections. Show mounting system and accessory items.
 2. Manufacturer must be capable to provide P.E. certified structural calculations.
 3. Manufacturer must be capable of providing initial application design assistance and consulting.
 4. Onsite services: Initial product installation supervision and onsite project review as necessary.
- E. Preinstallation Conference: Conduct conference at Project site. Agenda shall include, but not be limited to the following:
1. Review preparation, methods and procedures related to decorative metal installation.
 2. Review temporary protection requirements for decorative metal assembly during and after installation.
 3. Review curbs, connections, and condition of other construction that will affect decorative metal installation.
 4. Designation of area on job site to be used as work and storage location.
 5. Establish schedules and work methods which will prevent damage to decorative metal installation.
 6. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

10. DELIVERY, STORAGE, AND HANDLING

- A. Store decorative metal inside a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
- B. Deliver and store decorative metal products in wooden crates surrounded by sufficient packing material to ensure that products will not be cracked or otherwise damaged.
- C. All materials shall be protected during fabrication, shipment, site storage and erection to prevent damage to the finished work from other trades.
- D. Materials must be delivered in manufacturers original, unopened, undamaged containers with identification labels intact.
- E. Materials must be ordered according to manufacturer's instructions and delivery time should be planned to manufacturers quoted production schedule.
- F. Store ornamental metal screens inside a well-ventilated area, away from uncured concrete and masonry, and protected from weather, moisture, soiling, abrasion, extreme temperatures, and humidity.

11. SITE CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with decorative metal by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. If practical, provide allowance for trimming and fitting at site.

12. WARRANTY

- A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials, fabrication, or installation within specified warranty period. Warranty does not include normal weathering.
 - 1. Failures include:
 - a. Fading of gloss level.
 - b. Fading of color.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1. PERFORMANCE REQUIREMENTS

- A. General Performance: Ornamental metal screens shall withstand loads without failure due to defective manufacture, fabrication, installation, or other defects in construction.
- B. Structural Performance: Ornamental screens shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
- C. Corrosion Control: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

2. METALS
2

- A. Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
- B. Provide materials free from surface blemishes where exposed to view in finished unit. Surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished units are not acceptable. All metal shall be of architectural grade.

2. STAINLESS STEEL
3

- A. Tubing: ASTM A554, Grade MT 304.
- B. Pipe: ASTM A312/A312M, Grade TP 304.
- C. Sheet, Strip, Plate, and Flat Bar: ASTM A666, Type 304.
- D. Bars and Shapes: ASTM A276, Type 304.

2. STEEL AND IRON
4

- A. Tubing: ASTM A500/A500M (cold formed).
- B. Bars: Hot-rolled, carbon steel complying with ASTM A29/A29M, Grade 1010.
- C. Plates, Shapes, and Bars: ASTM A36/A36M.
- D. Castings: Either gray or malleable iron, unless otherwise indicated.
 - 1. Gray Iron: ASTM A48/A48M, Class 30, unless another class is indicated or required by structural loads.
 - 2. Malleable Iron: ASTM A47/A47M.
- E. Steel Sheet, Cold Rolled: ASTM A1008/A1008M, commercial steel, Type B, or structural steel, Grade 25 (Grade 170), exposed.
- F. For exterior installations and where indicated, provide tubing with hot-dip galvanized coating per ASTM A53/A53M.

6. FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Stainless-Steel Items: Type 316 stainless-steel fasteners.
 - 2. Uncoated Steel Items: Plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed, Type 316 stainless-steel fasteners where exposed.
 - 3. Galvanized Steel Items: Plated steel fasteners complying with ASTM B633, Class Fe/Zn 25 for electrodeposited zinc coating.
 - 4. Dissimilar Metals: Type 316 stainless-steel fasteners.
- B. The use of fasteners fabricated from the same basic metals and alloys as the fastened metals is required. Do not use metals that are dissimilar or incompatible with the materials joined. If designed metals are dissimilar, the use of a gasket or coating is mandatory.
- C. Fasteners for Anchoring to Other Construction: Unless otherwise indicated, select fasteners of type, grade, and class required to produce connections suitable for anchoring indicated items to other types of construction indicated.
- D. Provide concealed fasteners for interconnecting components and for attaching decorative metal items to other work, unless otherwise indicated exposed fasteners are unavoidable.
 - 1. Provide Phillips tamper-resistant flat-head machine screws for exposed fasteners, unless otherwise indicated.

7. MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
 - 1. For aluminum, 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.
- B. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.
 - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - 2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.
- C. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.
 - 1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. Shop Primer for Galvanized Steel: Zinc-dust, zinc-oxide primer formulated for priming zinc-coated steel and for compatibility with finish paint systems indicated, and complying with SSPC-Paint 5.
- E. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- F. Grout/Anchoring Cement: Non-shrink nonmetallic grout: CE CRD-C621 or erosion-resistant anchoring cement; non-staining, non-corrosive, nongaseous; recommended by manufacturer for types of applications indicated.

8. FABRICATION, GENERAL

- A. Assemble items in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.
- B. Form decorative metal to required shapes and sizes, true to line and level with true curves and accurate angles and surfaces. Finish exposed surfaces to smooth, sharp, well-defined lines and arris.
- C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- D. Form simple and compound curves in bars and extruded shapes by bending members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces.

- E. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm), unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- F. Mill joints to a tight, hairline fit. Cope or miter corner joints. Fabricate connections that will be exposed to weather in a manner to exclude water.
- G. Provide weep holes where water may accumulate.
- H. Provide necessary rebates, lugs, and brackets to assemble units and to attach to other work. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items, unless otherwise indicated.
- I. Comply with AWS for recommended practices in shop welding. Weld behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded joints of flux, and dress exposed and contact surfaces.
 - 1. Where welding and brazing cannot be concealed behind finished surfaces, finish joints to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 Welds: no evidence of a welded joint.
- J. Welded Connections: Use fully welded joints for permanently connecting components by welding. Cope or butt components to provide 100 percent contact or use manufacturer's standard fittings designed for this purpose.
- K. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- L. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- M. Provide wall returns, closed ends, brackets, flanges, fittings, and sleeves as required for type of installation indicated.

9. FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

10. STAINLESS-STEEL FINISHES

- A. Remove tool and die marks and stretch lines or blend into finish.
- B. Unless otherwise indicated, grind and polish surfaces to produce uniform finish indicated, free of cross scratches.
 - 1. Run grain of directionally textured finishes with long dimension of each piece.
- C. Directional Satin Finish: No. 4 finish.
- D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

11. STEEL AND IRON FINISHES

- A. Galvanizing: Hot-dip galvanize products made from rolled, pressed, and forged steel shapes, castings, plates, bars, and strips indicated to be galvanized to comply with ASTM A123/A123M.
 - 1. Hot-dip galvanize steel and iron hardware indicated to be galvanized to comply with ASTM A153/A153M.
- B. Fill vent and drain holes that will be exposed in finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparation for Shop Priming: After galvanizing, thoroughly clean decorative metal of grease, dirt, oil, flux, and other foreign matter, and treat with metallic-phosphate pre-treatment.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed decorative metal:
 - 1. Exteriors (SSPC Zone 1B): SSPC-SP 6, "Commercial Blast Cleaning."
 - 2. Interiors (SSPC Zone 1A): SSPC-SP 7, "Brush-off Blast Cleaning."
- E. Prepare galvanized steel items by removing all bumps, runs and drips from newly galvanized components following ASTM D7803 prior to application of powdercoating.

- F. Factory-Primed Finish: Apply air-dried primer immediately after cleaning and pre-treatment, to provide a minimum dry film thickness of 2 mils (0.05 mm) per applied coat, to surfaces that will be exposed after assembly and installation, and to concealed, non-galvanized surfaces.
- G. High-Performance Coating Finish: Comply with Division 9 Section "High-Performance Coatings."

PART 3 - EXECUTION

1. EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of decorative metal.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

2. INSTALLATION, GENERAL

- A. Provide anchorage devices and fasteners where needed to secure decorative metal to in-place construction.
- B. Perform cutting, drilling, and fitting required to install decorative metal. Set products accurately in location, alignment, and elevation; measured from established lines and levels. Provide temporary bracing or anchors in formwork for items to be built into concrete, masonry, or similar construction.
- C. Fit exposed connections accurately together to form tight, hairline joints or, where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding, and grinding are required for proper shop fitting and jointing of decorative metal, restore finishes to eliminate evidence of such corrective work.
- D. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete re-finishing, or provide new units as required.
- E. Install concealed gaskets, joint fillers, insulation, and flashings as work progresses.
- F. Restore protective coverings that have been damaged during shipment or installation. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - 1. Retain protective coverings intact; remove coverings simultaneously from similarly finished items to preclude non-uniform oxidation and discoloration.

- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal arc welding, for appearance and quality of welds, and for methods used in correcting welding work. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Grind exposed welded joints smooth and restore finish to match finish of adjacent surfaces.
- H. Insulate contact surfaces to prevent electrolysis due to metal-to-metal contact between metal and masonry or concrete.

3. CLEANING

- A. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.
- B. Clean metals according to the manufacturers or metal finishes written instructions in a manner that leaves an undamaged and uniform finish matching the approved sample.
- C. Unless otherwise indicated, clean metals by washing thoroughly with clean water and soap, rinsing with clean water, and drying with soft cloths.
- D. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material.
- E. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A780/A780M.

4. PROTECTION

- A. Protect finishes of decorative metal from damage during construction period with temporary protective coverings approved by decorative metal fabricator. Remove protective covering 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

DIVISION 06

WOOD, PLASTICS, AND COMPOSITES

SECTION 062013 – EXTERIOR SITE CARPENTRY

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Exterior Site Carpentry installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Site carpentry and framing of Wood Trellis, including wooden members (posts, beams, joists, rafters, blocking, etc) and similar items.
 - 2. Site carpentry and framing of Wood Decking, including wooden support framing members (posts, beams, joists, blocking, etc.) and wooden decking members (planks), and similar items.
 - 3. Accessories, including builder hardware and anchorage(s).
 - 4. Installation of metal fabricated items that are inclusive in the site carpentry.
 - 5. Miscellaneous rough carpentry, as required.
 - 6. Finished exterior carpentry, including appearance-grade select lumber where specified herein and in exposed exterior locations.
 - 7. Wood Finishing.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 055000 – Metal Fabrications.
 - 2. Section 099113 – Exterior Painting and Staining.
 - 3. Section 321323 – Site Concrete (for cast-in-place concrete footings).

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. AF&PA – American Forest and Paper Association.
 - 2. ALSC – USDA American Lumber Standards Committee.
 - 3. ANSI – American National Standards Institute.
 - 4. ASTM – American Society for Testing and Materials.
 - 5. ASME – American Society Mechanical Engineers standards.
 - 6. AWWA – American Wood Protection Association.
 - 7. FSC – Forest Stewardship Council.
 - 8. NEPA – National Fire Protection Association.
 - 9. NFPA – National Forest Products Association, National Design Specifications.
 - 10. NLGA – National Lumber Grades Authority.
 - 11. WCLIB – West Coast Lumber Inspection Bureau, Standard Grading and Dressing Rules.
 - 12. WWPA – Western Wood Products Association, Grading Rules for Western Lumber.
- B. Applicable Code: CBC - California Building Code, latest edition.
- C. Applicable Standards:

1. Unless noted otherwise latest edition, issue or revision applies.
2. PS (Product Standards) as referred herein by specification number.
3. West Coast Lumber Inspection Bureau Standard Grading and Dressing Rules.
4. Federal Specifications as referred to herein by number.

D. Definitions:

1. S4S: Dressed lumber, Sanded Four (4) Sides.
2. PTDF: Pressure-Treated Douglas Fir.

3. SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Product/Material Data. Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
2. Lumber Materials List: Indicate type of member, location, grade, specie, size, length and quantity.
3. Accessories (Hardware) Materials List.
4. Scaled Shop Drawings: Provide enlarged scaled plans, elevations, sections, as required, for review by the Architect and Structural Engineer, indicating dimensioned fabrication and erection of Site Carpentry units. Show construction including foundations, structural materials and components, wood members, joining materials, splices, corbels, insets, reveals, or notching/boring holes for conduits, wiring, or other items attached to or concealed in the Site Carpentry Work.
5. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience on similar Site Carpentry projects. Include lists of completed projects with project names and addresses, reference names and addresses and the type of Site Carpentry installed.
6. Maintenance Program: Submit Manufacturer-recommended program for maintenance of each type of Exterior Site Carpentry indicated herein.

C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable). Provide samples with sealer applied to wood members for Owner's and Architect's review and approval.

1. Wood Trellis: Provide of wood members of varying roughness ranging from light to medium re-sawn texture, each with applicable paint/stain finishes (as indicated in Section 099113 – Exterior Painting and Staining).

- D. Field-Constructed Mock-ups: Prior to the installation of Work in this Section, erect Field-Constructed Mock-up to verify selections made under the Submittals Article and to demonstrate aesthetic effects as well as qualities of materials and execution. Build Field-Constructed Mock-ups to comply with the following requirements, using materials indicated for final Unit of Work, including same base construction, joints, and contiguous work as indicated.
1. Locate Field-Constructed Mock-ups in the location and of the size indicated or, if not indicated, as directed by the Architect:
 - a. Size: Provide one (1) Field-Constructed Mock-up for each Site Carpentry type indicated herein this Section. Each Mock-up shall measure 4'-0" wide x 6'-0" long.
 2. Notify the Architect at least one (1) week in advance of the dates and times when the Field-Constructed Mock-up will be erected and ready for review.
 3. Demonstrate the proposed range of aesthetic effects and workmanship in the Field-Constructed Mock-up that will be produced in final unit of Work.
 4. Obtain the Landscape Architect's acceptance of the Field-Constructed Mock-up, in writing, prior to the start of the final Unit of Work. An accepted Mock-up is a prerequisite to commencing Work under this Section.
 5. Retain and maintain Field-Constructed Mock-ups during construction in an undisturbed condition. Accepted Field-Constructed Mock-ups shall be the standard for judging the completed Work under this Section.
 6. Demolish and remove the Field-Constructed Mock-ups when directed by the Architect.
 7. Accepted Field-Constructed Mock-ups may become part of the completed Work, if directed by the Landscape Architect.
 8. When the Landscape Architect determines that a Field-Constructed Mock-up does not meet requirements, retain it for reference and construct another Mock-up until it is accepted.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- F. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.

4. QUALITY ASSURANCE.AND CONTROL

- A. Installer Qualifications: Engage an experienced Installer with experience in successfully demonstrating the fabrication, installation, and completion of Site Carpentry Work similar in material, design, and extent to that indicated for this Project, with a record of successful performance, and with sufficient production capacity to produce required units without causing delay in the Work.
- B. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
- C. Single-Source Responsibility: Obtain each color, type, and variety of Site Carpentry lumber, joint materials, and setting materials from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- D. Pre-installation Conference:

1. Before installing Work as indicated herein this Section, conduct a Pre-installation Conference at the Project Site with the Architect to review requirements and design objectives, including a review of textures, colors, finishes, layouts, and other design intents of the Work. Conference shall be held prior to erecting the Field-Constructed Mock-up Samples.
 2. Notify participants in writing at least five (5) working days prior to Conference.
5. DELIVERY, STORAGE AND HANDLING.
- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft and damage.
 - B. Deliver manufactured materials in original, unopened packages or containers with manufacturer's labels intact and legible.
 - C. Store materials off ground and under cover, away from damp surfaces and inclement weather. Protect materials during storage and construction against contamination from earth and other materials.
 1. Wrap lumber materials in plastic or use other packaging materials that will prevent rust marks from steel strapping used in shipping.
 2. Deliver and unload materials at the Project Site in such a manner that no damage occurs to the products or materials.
 3. Store lumber and timber in neat stacks at the site. Stack so that it may be readily inspected.
 4. Pile structural timber neatly on skids above ground with spacers to allow free air circulation.
 5. Protect from termites, decay, rain and excessive sun.
 - D. Deliver and install materials so as to not delay Work, and install only after preparation for installation have been completed.
 - E. Handling:
 1. Handle lumber and timber in a manner that will avoid injury or breakage.
 2. Handle treated timber with rope slings. Do not use cant hooks, peaveys, or other sharp instruments in handling treated timber. Undue injury in handling will be cause for rejection.
6. COORDINATION, SCHEDULING, AND OBSERVATIONS
- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
 - B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Architect prior to commencing Work.
 - C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities.

- D. Grades and Levels: Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work in this Section with other Work affected.
- E. Excavation of Foundations: When conditions detrimental to adequate installation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- F. Perform installation operations only when weather is suitable in accordance with locally accepted practices.
- G. Sequence and Scheduling:
 - 1. Verify and obtain location and size of rough openings, bracing and blocking required to accommodate the work of other sections into the carpentry work.
 - 2. Layout: Furnish layouts for foundation bolts and framing anchors in concrete.
 - 3. Adjustments: Determine foundation adjustments required in framing to obtain required levels and alignments.
- H. Construction Site Observations: Landscape Architect may observe installation of Site Carpentry Work at Project Site for compliance with requirements for type, size, and quality. Architect retains right to observe Site Carpentry Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected Work immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Architect are required.

7. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. LUMBER

- A. General:
 - 1. Use only lumber conforming to grades and dress sizes permitted within the applicable grading rules.

2. Lumber shall be new, uniformly sized unless otherwise noted on the Contract Drawings.
3. Mark each piece of lumber for use in structural framing with the grade and trade mark of a lumber grading organization.
4. Moisture Content: All lumber after treatment shall be either air or kiln dried so that material at time of shipment and delivery does not exceed 15% moisture content.

B. Structural / Framing Lumber:

1. Select grade, dressed S4S, Pressure Treated Douglas Fir (PTDF).
 - a. Refer to requirements listed herein this Section for Preservative Treatment.

C. Appearance Grade, Select Lumber:

1. General: Provide material hand selected for freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot holes, shake, splits, torn grain, and wane.
2. Trellis Structure: Provide appearance grade, select clear #1 free of heart, re-sawn (per approved texture) lumber for all exposed wood. Lumber members shall be straight and true, with no bends, curves, excessive gouges, chips, or cracks.
 - a. Type: Douglas Fir.

2. FASTENERS

A. General:

1. Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2" into wood substrate.
2. Builders Rough Hardware: As needed, all new materials, of standard manufacture as designated on the Contract Documents or specified herein, or subject to prior acceptance by the Architect.
3. Nails: Common wire nails conforming to Federal Specification FF-N105B, meeting ASTM F1667, and according to the nailing schedule. Use galvanized nails for all exterior exposed nailing.
4. Bolts, Lag Screws, Wood Screws, Washers: Carbon steel conforming to Federal Specifications FF-B-561C, FF-B-575C, FF-B-0584D and/or FF-S-111C. Items exposed to the weather shall be hot-dipped galvanized, all other items shall be unfinished unless otherwise shown on the Contract Drawings.
 - a. Wood Screws: Meet ASME B18.6.1.
 - b. Lag Screws: Meet ASME B18.2.3.8M.
 - c. Stainless Steel Bolts: Meet ASTM F738M, Grade A1 or A4, with ASTM F836M, Grade A1 or A4 Hex Nuts, and flat washers.
 - d. Post-Installed Anchors: Stainless steel, chemical anchors with capability to sustain, without failure, a load equal to six (6) times the load imposed when installed in unit masonry assemblies and equal to four (4) times the load imposed when installed in concrete as determined by testing per ASTM E488, conducted by a qualified independent testing and inspection agency.
 - 1) Stainless steel bolts and nuts complying with ASTM F738M and ASTM F836M, Grade A1 or A4.
5. Powder Actuated Anchors: Not used.
6. Decorative Hardware (Washers, Brackets, etc.): Malleable Iron, sized to fit.

3. METAL FRAMING ANCHORS

- A. Brackets, Hangers and Framing Clips (where non-custom manufactured products are indicated): Provide products indicated on Contract Drawings or comparable products:
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Simpson Strong Tie Co.
 - b. Teco Products.
 - c. KC Metal Products.
 - d. USP Structural Connectors.
 - e. Or equal, as approved by the Landscape Architect.
 - 2. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meets or exceeds those of products or manufacturer listed. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
 - 3. Stainless Steel Sheet: Meet ASTM A666, Type 316L.
 - B. Cast-in-Place Concrete Footings or Slabs: Refer to Section 321323 – Site Concrete.
 - C. Steel or Other Structural Members: Conform to applicable UBC, CBC, and ASTM standards, as acceptable to Landscape Architect.
 - 1. Trellis Structure Decorative Hangars: Steel, Galvanized Finish, primed and painted per Section 099113 – Exterior Painting and Staining. Size per Structural Engineer.
4. PRESERVATIVE TREATMENT
- A. Pressure-treat boards and structural/dimensional lumber with waterborne preservative according to American Wood Preserver's Association AWPA C2.
 - B. Preservative Chemicals: Acceptable to authorities having jurisdiction.
 - C. Application: Treat framing members, sills & ledgers, members in contact with concrete or masonry, and posts.
5. FINISHING
- A. Finishing for Wood Trellis: Refer to Contract Drawings and per Section 099113 – Exterior Painting and Staining.

3.EXECUTION

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

- B. Where required, prime lumber to be painted, including both faces and edges. Cut to required lengths and prime ends. Comply with requirements per Section 099113 – Exterior Painting and Staining.

3. ERECTION, GENERAL

- A. Set exterior site carpentry to required levels and lines, with members plumb, true to line, cut and fitted. Fit exterior site carpentry to other construction, scribe and cope as needed for accurate fit.
- B. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Do not splice structural members between supports unless otherwise indicated.
 - 1. Cutting or notching of structural members is not permitted, except as directed by Structural Engineer or shown on Contract Drawings.
 - 2. Cutting of Beams, Joists, Rafters, and Boring of Holes: Is not allowed unless approved by the Structural Engineer.
- D. Erect Framing Structure in accordance with the Contract Drawings, at the maximum specified moisture content indicated, including preparatory Work for subsequent trades and conditions not actually detailed.
 - 1. Saw-cut lumber and timber framing accurately.
 - 2. Framing Standard: Frame, brace, nail and bolt according to NFPA's "National Design Specification for Stress-Grade Lumber and its Fastenings".
- E. Fasteners, General: Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view. Make tight connections between members. Install fasteners without splitting wood.
- F. Bolting:
 - 1. Pre-drill holes for countersunk bolts with a bit 1/16 in. larger than the accompanying washer, and to a depth, which allows bolt, and washer head to be secured flush with finish surface.
 - 2. Counter sink depth 1" as required for wood plug success.
 - 3. Where bolts are not countersunk, bore hole to accept bolt only.
 - 4. Tighten bolts used in carpentry work and retighten shortly before being covered by other Work or before completion of job.
 - 5. Nick bolts to prevent nut loosening.
 - 6. Tighten bolt and washers flush to finish surface without compressing wood.
- G. Screwing:
 - 1. Screw, do not drive, wood screws and lag screws with complete penetration up to head.
 - 2. Bore lead holes about 3/4 of diameter and same depth as shank.
 - 3. Continue holes to a depth equal to length of the screw, but with diameter about 3/4 of thread root.
 - a. Use size of drill to fit manufacturers dowel for first row of deck per manufacturer's requirements.
 - 4. Lengths and embedments as indicated.
 - a. Unless noted otherwise, countersink screws until heads are flush with finish surface.

- H. Nailing:
 - 1. Where nailing is allowed by the Landscape Architect, sub-drill holes for nails in all pieces where splitting may occur.
 - 2. Size of hole shall be slightly smaller than diameter of nail or spike.
 - 3. Do not drive nails closer together than 1/2 length of nail or spike and not closer to edge of lumber than 1/4 length of nail or spike.
 - 4. Penetration of nails or spikes shall be not less than 1/2 length of nail or spike, except that 16d nails may be used to connect together 2x pieces.
 - 5. Seat flush.
 - 6. Countersink all finishing nails to 1/16 in. below finish surface. Nails will not be allowed for finished surfaces of Wood Decking.
 - 7. Remove lumber split in nailing and replace with new members bored for nails as specified.
- I. Washers:
 - 1. Cut Washers: Fit all bolts 5/8 in. in diameter or less with cut washers.
 - 2. Cast Washers: Fit all bolts and lag screws over 5/8 in. in diameter with cast or malleable iron washers, unless otherwise shown on the Contract Drawings.
- J. Metal Framing Anchors:
 - 1. Install in accordance with selected manufacturer's written instructions.
 - 2. Fasten framing anchors and steel bridging with galvanized special nails furnished with hardware in every nail hole. Conform to nailing schedule for hardware not supplied with special nails.
- K. Trellis members and beams: Install with crowned edge up. Cut members making structural contact with bearings or each other for full bearing. Provide splices, as required, per direction of the Structural Engineer. Trim off splits at ends of bearings for structural members.

4. FINISHING

- A. General:
 - 1. Edge Treatment: Exposed edges or leading corners shall be eased.
 - 2. Exposed Surfaces: Sand smooth before application of finish coats. Verify with Landscape Architect prior to sanding.
- B. Wood Members for Trellis:
 - 1. Contractor may provide sandblasted finish to wood members after erection in lieu of providing milled re-sawn lumber members prior to erection. If chosen, sandblasted finish shall match milled re-sawn texture, per the sole discretion of the Landscape Architect.
 - 2. Painting or Staining: Refer to Contract Drawings and per Section 099113 – Exterior Painting and Staining. Finished surfaces shall be uniform in appearance and not mottled.

5. FIELD QUALITY CONTROL

- A. Workmanship: Workmanship shall be first class throughout, and free of hammer marks, dents or other disfiguration. Unless otherwise specified, lumber shall not show saw marks.

END OF SECTION 062013

SECTION 06 68 13 - SOLID SURFACE PANELING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Solid surface wall panels and base at Restrooms.

1.3 RELATED SECTIONS

- A. Section 123661.16 - Solid Surfacing Countertops.

1.4 SEQUENCING AND SCHEDULING

- A. Coordinate construction activities in this Section with construction activities specified in related Sections or other construction activities required for fabrication and installation.

1.5 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data indicating compliance with specified performance requirements.
 - 1. Accessories: Submit manufacturer's product data and installation instructions.
- B. Shop Drawings: Submit top views, elevations and sections (as needed). Indicate dimensions, material thickness, location and sizes of cutouts, anchorage provisions and attachment methods. Indicate coordination requirements with adjacent and interfacing work.
- C. Samples: 6- by 6-inch samples or as requested; indicate full color range and pattern variation. Approved samples will be standard for cast marble.

1.6 INFORMATIONAL SUBMITTALS

- A. Quality Assurance submittals outlined below.
- B. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data. Manufacturer's data indicating cleaning and maintenance

requirements.

- B. Warranty: Executed special warranty specified in this Section.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate stone countertops similar to that indicated for this Project and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of products.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Packing and Shipping: Pack countertops and other flat products in wooden crates to minimize damage in shipping.
- B. Acceptance at Site: Supervise unloading of materials. Check for damaged crates. Mark bill of lading if there is any obvious damage and notify marble supplier immediately. Otherwise, proceed with offloading crates.
- C. Store quartz surfacing on wood A-frames or pallets with nonstaining separators and nonstaining, waterproof covers. Ventilate under covers to prevent condensation.
- D. Protection: Handle materials to prevent physical damage. Protect surfaces from staining, scratching and other damage during handling.

1.10 SITE CONDITIONS

- A. Field Measurements: Verify dimensions of construction to receive solid surfacing wall panels by field measurements before fabrication and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Provide manufacturer's ten-year limited warranty against product defects when fabricated and installed by an approved, manufacturer-certified fabricator.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIAL

- A. Solid Polymer Components:
 - 1. Basis-of-Design Product: The design for the solid surface paneling is based on the manufacturer identified below. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - a. Basis-of-Design (W3): Formica Everform; Sea Grass 505
 - b. Corian; DuPont Commercial Surfaces.
 - c. Lotte Chemical, USA.
 - d. Accepted equivalent.
 - 2. Cast, nonporous, filled polymer, not coated, laminated or of composite construction with through body colors meeting ANSI Z124.3 or ANSI Z124.6,

having minimum physical and performance properties specified.

3. Superficial damage to a depth of 0.010 inch (25 mm) shall be repairable by sanding and/or polishing.
- B. Thickness: 1/2 inch minimum.
- C. Edge treatment: As indicated.
- D. Dimensions: As shown on Drawings.

2.2 ACCESSORIES

- A. Joint adhesive: Manufacturer's standard one- or two-part adhesive kit to create inconspicuous, nonporous joints.
- B. Sealant: Manufacturer's standard mildew-resistant, FDA-compliant, NSF 51-compliant (foodzone — any type), UL-listed silicone sealant in colors matching components.

2.3 FABRICATION

- A. Shop assembly:
 1. Fabricate components to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer's printed instructions and technical bulletins.
 2. Form joints between components using manufacturer's standard joint adhesive without conspicuous joints.
 3. Provide factory cutouts for plumbing fittings and restroom accessories as indicated on the drawings.
 4. Rout and finish component edges with clean, sharp returns.
 - a. Rout cutouts, radii and contours to template.
 - b. Smooth edges.
 - c. Repair or reject defective and inaccurate work.
- B. Vertical surface joints:
 1. 1/2-inch-thick solid polymer material, with 1/8-inch-wide joints, hot-welded together; adhesively applied to solid substrates with matching color.
- C. Finish: Provide surfaces with a uniform finish.
 1. Gloss: Semigloss; gloss range of 20–50.
- D. Color(s): As indicated on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Site Verification:
 1. Verify dimensions by field measurements prior to fabrication.
- B. Inspect paneling surfaces for damage. Do not install until damage materials have been repaired in an acceptable manner or replaced.

3.2 PREPARATION

- A. Advise installers of other work about specific requirements for placement of inserts and similar items to be used by resin paneling Installer for anchoring panels. Furnish installers of other work with Drawings or templates showing locations of these items.

- B. Protect finished surfaces against scratches. Apply masking where necessary. Guard against grit, dust, and other trades.

3.3 INSTALLATION - GENERAL

- A. Install components in accordance with reviewed shop drawings and plans.
- B. All materials to be plumb, level and rigid. Neatly scribe to adjoining surfaces.
- C. Field trim all components as needed to fit field conditions.
- D. Immediately replace any material that is cracked, chipped, broken or otherwise defective.
- E. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.
 - 1. Provide product in the largest pieces available.
 - 2. Form field joints using manufacturer's recommended adhesive, with joints inconspicuous in finished work.
 - a. Exposed joints/seams shall not be allowed.
 - 3. Reinforce field joints with solid surface strips extending a minimum of 1 inch on either side of the seam with the strip being the same thickness as the top.
 - 4. Cut and finish component edges with clean, sharp returns.
 - 5. Rout radii and contours to template.
 - 6. Carefully dress joints smooth, remove surface scratches and clean entire surface.

3.4 ADJUSTING

- A. Repair or replace damaged materials in a satisfactory manner.

3.5 CLEANING

- A. Remove masking and excess adhesives and sealants. Clean exposed surfaces.
- B. Clean installed units not more than 48 hours prior to Date of Substantial Completion. Repair or replace damaged or stained cast marble work.
- C. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

3.6 PROTECTION

- A. Protect all finished work until final acceptance by CITY ENGINEER.

END OF SECTION 066813

DIVISION 07

Thermal and Moisture Protection

SECTION 071416 - COLD FLUID-APPLIED WATERPROOFING

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Cold Fluid-Applied Waterproofing installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, products installed but not furnished under this Section, as follows:
 - 1. Surface preparation and substrate treatment.
 - 2. Cold Fluid-Applied Waterproofing Membrane.
 - 3. Composite Molded Sheet Drainage Panels.
 - 4. Sheet Flashings and Accessories.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 042200 – Unit Masonry.
 - 2. Section 321323 – Site Concrete.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ANSI – American National Standards Institute.
 - 2. ASTM – American Society for Testing and Materials.
 - 3. SWRI – Sealant, Waterproofing & Restoration Institute.
- B. Standards of Construction:
 - 1. ASTM C836 – Standard Specification for High Solids Content, Cold Liquid-Applied Elastomeric Waterproofing Membrane for Use with Separate Wearing Course.
 - 2. ASTM C1471 – Guide for the Use of High Solids Content Cold Liquid-Applied Elastomeric Waterproofing Membrane on Vertical Surfaces.
 - 3. *Sealants: The Professional's Guide*, Sealant, Waterproofing & Restoration Institute (SWRI).

3. PERFORMANCE REQUIREMENTS

- A. General: Provide Cold Fluid-Applied Waterproofing that prevents the passage of liquid water under hydrostatic pressure and complies with physical requirements of ASTM C836 as demonstrated by testing performed by an independent testing agency of manufacturer's current waterproofing formulations.

4. SUBMITTALS

- A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
1. Product/Material Data: Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements, including instructions for evaluating, preparing, and treating the substrate, technical data, and tested physical and performance properties.. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material:
 - a. Cold Fluid-Applied Waterproofing Membrane.
 - b. Composite Molded Sheet Drainage Panels.
 - c. Sheet Flashings and Accessories.
 2. Scaled Shop Drawings: Submit enlarged scaled plans, elevations, sections, details, as required, showing locations and extent of waterproofing, including details for substrate joints and cracks, sheet flashings, drainage panels, penetrations, and other termination conditions.
 3. Product Test Reports: Submit from a qualified independent testing agency evidencing compliance of waterproofing with requirements based on comprehensive testing of current product formulations.
 4. Warranty and Special Warranty Information: Submit information; refer to Article herein this Section for requirements.
 5. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities, experience, and certification requirements on similar waterproofing installations.
 - a. Manufacturer Qualifications.
 - b. Installer Qualifications.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
1. Submit a twelve-inch (12") x twelve-inch (12") minimum size of each waterproofing material required for Project:
 - a. Cold Fluid-Applied Waterproofing Membrane.
 - b. Composite Molded Sheet Drainage Panels.
 - c. Sheet Flashings and Accessories.
- D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect.

5. QUALITY ASSURANCE AND CONTROL

- A. **Installer Qualifications:** Engage an experienced Installer, who is certified in writing by waterproofing manufacturer, as qualified to install Manufacturer's waterproofing, and who has completed similar waterproofing installations similar to that indicated for this Project for a minimum of five (5) continuous years.
- B. **Manufacturer Qualifications:** Engage a firm experienced in manufacturing cold fluid-applied waterproofing similar to that indicated for this Project and that has a record of successful in-service performance for a minimum of five (5) continuous years.
- C. **Single-Source Responsibility:** Obtain waterproofing materials from a single Manufacturer regularly engaged in manufacturing waterproofing, with resources to provide products/materials of consistent quality in appearance and physical properties without delaying Work
- D. **Field-Constructed Mock-Up:** Apply a fluid waterproofing and composite molded sheet drainage panel field sample to a one-hundred square-foot (100 SF) area to demonstrate surface preparation, joint and crack treatment, thickness, texture, and standard of workmanship, which is to be used as the basis for judging quality of workmanship throughout the project
 - 1. Notify Landscape Architect one (1) week in advance of the dates and times when field Field-Constructed Mock-Up will be prepared.
 - 2. If Landscape Architect determines that a Field-Constructed Mock-Up does not meet requirements, reapply waterproofing until Mock-Up is approved.
 - 3. Retain and maintain approved Field-Constructed Mock-Up during construction in an undisturbed condition as a standard for judging the completed waterproofing. An undamaged field sample may become part of the completed Work.
- E. **Pre-Installation Conference:** Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. Before installing waterproofing, meet with Owner, Landscape Architect, consultants, independent testing agency, waterproofing manufacturer, and other concerned entities.
 - 2. Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, inspection and testing procedures, and protection and repairs.
 - 3. Notify participants at least three (3) working days before Conference.

6. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original containers with seals unbroken, labeled with Manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing Manufacturer. Protect stored materials from direct sunlight.
- C. Remove and replace material that cannot be applied within its stated shelf life.
- D. Deliver and install materials so as to not delay Work, and install only after preparations for installation have been completed.

7. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Environmental Limitations: Apply Cold Fluid-Applied Waterproofing within the range of ambient and substrate temperatures recommended by the Manufacturer. Do not apply Cold Fluid-Applied Waterproofing to a damp or wet substrate, when relative humidity exceeds eighty-five-percent (85%), or when temperatures are less than 5 deg F above dew point.
 - 1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during the application and curing period.
- B. Maintain adequate ventilation during application and through complete curing of waterproofing materials.
- C. Grades and Levels: Maintain required levels and grade elevations. Review installation procedures and coordinate Work in this Section with other Work affected.
- D. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work. Check actual locations of finished surface grades, finished grades, and other construction to which Cold Fluid-Applied Waterproofing is installed, by accurate field measurements before installation. Do not install Waterproofing that is exposed to view as part of the final Unit of Work.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

8. WARRANTY

- A. General Warranty: Special Warranty specified herein in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.
- B. Special Warranty: Submit a written Warranty, signed by waterproofing Manufacturer and Installer, agreeing to repair or replace waterproofing that does not meet requirements or that does not remain watertight within the specified Warranty period. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.
 - 1. Warranty Period: Three (3) years after date of Substantial Completion.

2.PRODUCTS

1. MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide products by one (1) of the following: <<<SELECT>>>
 - 1. Single-Component Modified Polyurethane:

- a. *A-H Seamless Membrane I-R*; Anti-Hydro International, Inc.
- b. *QSC-525*; Carlisle Corporation, Carlisle Coatings & Waterproofing Div.
- c. *HLM 5000*; ChemRex Inc., Sonneborn Building Products Div.
- d. *Neogard 7403/7405*; Jones-Blair, Neogard Div.
- e. *One-Kote System*; Karnak Corporation.
- f. *Vulkem 201*; Mameco International, Inc.
- g. *Mult-I-Thane 3000*; Multi-Chemical Products, Inc.
- h. *Miraseal*; Nicolon/Mirafi Group.
- i. *Duramem H-500/V-500*; Pecora Corporation.
- j. *Tremproof 60*; Tremco.
- k. *Elastall 1000*; United Coatings.
2. Two-Component Modified Polyurethane:
 - a. *Futura-Flex 518*; Futura Coatings, Inc.
 - b. *LM-60*; Gaco Western Inc.
 - c. *Vulkem 222*; Mameco International, Inc.
3. Single-Component Unmodified Polyurethane:
 - a. *Permagard 7410*; Jones-Blair, Neogard Div.
 - b. *Vulkem 101*; Mameco International, Inc.
 - c. *Scotch Clad 5893/5864*; 3M Construction Markets.
4. Two-Component Unmodified Polyurethane:
 - a. *Sure-Seal Liquiseal*; Carlisle Corporation, Carlisle Coatings & Waterproofing Div.
 - b. *Vulkem 102*; Mameco International, Inc.
 - c. *Isoflex 550 SP*; Peterson: Harry S. Peterson Co.

2. WATERPROOFING MATERIALS

- A. General: Provide waterproofing materials recommended by Manufacturer to be fully compatible with and able to develop bond to substrate under conditions of service and application required, as demonstrated by waterproofing Manufacturer based on testing and field experience.

1. Compound waterproofing for vertical or horizontal application and slope of substrate indicated. Provide waterproofing with not less than ninety percent (90%) solids.

<<<SELECT ONE FROM BELOW>>>

- a. Single-Component, Bitumen-Modified Polyurethane, complying with performance and physical requirements of ASTM C836, and with manufacturer's printed physical requirements as certified by a qualified independent testing agency.
- b. Two-Component, Bitumen-Modified Polyurethane, complying with performance and physical requirements of ASTM C836, and with manufacturer's printed physical requirements as certified by a qualified independent testing agency.
- c. Single-Component, Unmodified Polyurethane, complying with performance and physical requirements of ASTM C836, and with manufacturer's printed physical requirements as certified by a qualified independent testing agency.
- d. Two-Component, Unmodified Polyurethane, complying with performance and physical requirements of ASTM C836, and with manufacturer's printed physical requirements as certified by a qualified independent testing agency.

3. AUXILIARY MATERIALS

- A. Primer: Manufacturer's standard factory-formulated polyurethane or epoxy primer.
- B. Sheet Flashing: 50-mil- minimum, non-staining uncured sheet neoprene.
1. Adhesive: Manufacturer's recommended contact adhesive.

- C. Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.
 - D. Joint Sealant: Multi-component polyurethane sealant complying with ASTM C920 Type M, Class 25, Grade NS for sloping and vertical applications or Grade P for deck applications. Use NT and as recommended by Manufacturer for substrate and joint conditions and for compatibility with waterproofing.
 - 1. Backer Rod: Closed-cell polyethylene foam.
 - E. Protection Course: Semi-rigid sheets of fiberglass or mineral reinforced-asphaltic core, pressure laminated between 2 asphalt-saturated fibrous liners, and as follows:<<<SELECT>>>
 - 1. Thickness: 1/8 inch, nominal.
 - 2. Thickness: 1/4 inch, nominal.
 - 3. Thickness: 1/8 inch, nominal, for vertical applications; 1/4 inch, nominal, elsewhere.
 - 4. Adhesive: Rubber-based, solvent type recommended by membrane manufacturer for type of protection course.
4. COMPOSITE MOLDED-SHEET DRAINAGE PANELS
- A. General: Pre-fabricated geo-composite Molded Sheet Drainage Panels, three (3)-dimensional dimpled core, 36 to 60 inches wide, non-biodegradable, manufactured with a permeable geotextile filter fabric bonded to molded-plastic-sheet drainage core, designed to effectively convey water.
 - 1. When Molded Sheet Drainage Panels are installed in conjunction with the Cold Fluid-Applied Waterproof Membrane product, Contractor shall be responsible to verify that the waterproofing/drainage products must be compatible and installed by methods acceptable to the waterproofing and drainage product manufacturers.
 - B. Composite Molded Sheet Drainage Panels:
 - 1. Drainage Core: Three-dimensional, non-biodegradable, molded polypropylene or polystyrene.
 - a. Minimum compressive strength of 10,000lbf/sq. ft. when tested according to ASTM D1621.
 - b. Minimum in-Plane Flow Rate for Vertical Applications: 12.5 gpm/foot at 1.0 hydraulic gradient, and 3600-psf normal pressure when tested according to ASTM D4716.
 - c. Minimum in-Plane Flow Rate for Horizontal Applications: 12.5 gpm/foot at 0.5 hydraulic gradient, and 3600-psf normal pressure when tested according to ASTM D4716.
 - d. Creep: Model long-term compression of the prefabricated drainage composite system and determine if the drain product flow channels become restricted with time. Long-term creep/drainage performance shall be determined by measuring flow after 300 continuous hours under the above referenced normal pressure. The test method shall utilize a loading system that models the soil/drainage product interaction.
 - e. Flow Direction: Flow shall be measured on only one (1) side of the core. Where the core geometry differs in principal directions, flow shall be measured in both directions, simulating water flowing vertically down a wall and horizontally across the face of the wall to accurately determine maximum flow rate in critical principal direction.
 - 2. Geotextile Filter Fabric, for Vertical Applications: Non-woven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters, with elongation greater than 50%, complying with the following properties determined to AASHTO M288:

- a. Survivability: Class 2.
 - b. Apparent Size Opening: No. 40 sieve, maximum.
 - c. Permittivity: 0.5 per second, minimum.
 3. Geotextile Filter Fabric, for Horizontal Applications: Woven needle-punched geotextile, manufactured for subsurface drainage, made from polyolefins or polyesters, with elongation greater than 50%, complying with the following properties determined to AASHTO M288:
 - a. Survivability: Class 2.
 - b. Apparent Size Opening: No. 40 sieve, maximum.
 - c. Permittivity: 0.5 per second, minimum.
 4. Film Backing: Plastic, protective-film, backing sheet attached to surface facing waterproofing.
- C. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 1. Carlisle Coatings and Waterproofing, MiraDRAIN.
 2. American Wick Drain Corporation.
 3. Cosella-Dorken.
 4. Eljen Corp.
 5. Greenstreak.
 6. JDR Enterprises.
 7. LINQ Industrial Fabrics, Inc.
 8. Midwest Diversified Technologies, Inc.
 9. TC Mirafi.
 10. WR Meadows.

3.EXECUTION

1. EXAMINATION

- A. Examine substrates, areas, and conditions under which waterproofing systems will be applied, with Installer present, for compliance with requirements. Do not proceed with installation until unsatisfactory conditions have been corrected. Do not proceed with drainage installation until substrate conditions are acceptable for compliance with manufacturer's warranty requirements.
 1. Do not proceed with installation until after the minimum concrete curing period recommended by waterproofing Manufacturer.
 2. Verify substrate is visibly dry and free of moisture. Test for capillary moisture by the plastic sheet method according to ASTM D4263.
 3. Notify Landscape Architect in writing of anticipated problems using waterproofing over substrate.

2. SURFACE PREPARATION

- A. Clean and prepare substrate according to manufacturer's recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.
- C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

- D. Remove grease, oil, form release agents, paints, and other penetrating contaminants from concrete. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.
 - 1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D4259 with a self-contained, re-circulating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form release agents. Remove remaining loose material and clean surfaces according to ASTM D4258.

3. PREPARATION AT TERMINATIONS AND PENETRATIONS

- A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C898 and Manufacturer's recommendations.
- B. Prime substrate when recommended by waterproofing Manufacturer.
- C. Apply a double thickness of waterproofing and embed a joint reinforcing strip in preparation coat when recommended by waterproofing Manufacturer.
 - 1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing Manufacturer.

4. JOINT AND CRACK TREATMENT

- A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C898 and waterproofing manufacturer's recommendations. Remove dust and dirt from joints and cracks complying with ASTM D4258 prior to coating surfaces.
 - 1. Comply with recommendations of ASTM C1193 for joint sealant installation.
 - 2. Apply bond breaker between sealant and preparation strip when required by waterproofing Manufacturer.
 - 3. Prime substrate when recommended by waterproofing manufacturer and apply a single thickness of preparation strip extending a minimum of three-inches (3") along each side of joint. Apply a double thickness of waterproofing and embed a joint reinforcing strip in preparation coat when recommended by waterproofing Manufacturer.
- B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing Manufacturer's recommendations.
 - 1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C898 and as recommended by waterproofing Manufacturer.

5. WATERPROOFING APPLICATION

- A. Apply waterproofing according to ASTM C898 and Manufacturer's recommendations.
- B. Start installing waterproofing in presence of Manufacturer's technical representative.
- C. Apply primer over prepared substrate when recommended by Manufacturer and at Manufacturer's recommended rate.
- D. Mix materials according to Manufacturer's instructions.

- E. Apply waterproofing, according to Manufacturer's recommendations, by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.
- F. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
- G. Apply waterproofing to prepared wall terminations and vertical surfaces to heights indicated according to Manufacturer's recommendations and details.
- H. Verify wet film thickness of waterproofing every 100 sq. ft.
- I. Install protection course with butted joints over nominally cured membrane no later than recommended by Manufacturer and before starting subsequent construction operations.
 - 1. Molded-sheet drainage panels may be used in lieu of protection course to vertical applications when approved by waterproofing Manufacturer.

6. COMPOSITE MOLDED SHEET DRAINAGE PANEL INSTALLATION

- A. Place and secure Drainage Panels to substrate, according to Manufacturer's written instructions.
 - 1. Coordinate placement with other drainage materials.
 - 2. Position the Panel with the flat side against the wall, and filter fabric toward the soil/drainage side. Insure the side against the wall lays flat.
 - 3. Place core side of Panel against wall.
 - 4. Use adhesives and mechanical fasteners recommended by Manufacturer that do not penetrate waterproofing.
 - 5. If additional Panels are required on same row, cut away four-inches (4") of installed Panel core, install new Panel against installed Panel, and overlap new Panel with installed Panel Fabric.
 - 6. If additional rows of Panels are required, overlap lower Panel with four-inches (4") of fabric.
 - 7. For inside corners, bend Panel.
 - 8. For Outside corners, cut core to provide three-inches (3") of overlap to maintain continuity.
 - 9. Protect installed panels during subsequent construction.

7. DISCHARGE CONNECTIONS

- A. Sub-surface Drainage Piping for Discharge: Refer to Composite Molded Sheet Drainage Panel Manufacturer's directions for connections of Drainage Panels to Drainage Piping.
- B. Weep Holes: Cut a hole in the core corresponding to the size and location of the weep hole. Avoid cutting a hole in the fabric by cutting the backside of the core between the dimples. A four dimple square area cut between the dimples (2 ½ square inch) should be sufficient for most applications.
- C. Drains: Create openings in the Drainage Panels core to correspond with all discharge holes in the Drain. Fabric must be placed over these holes to prevent intrusion of soil, grout, sand, or concrete into the drainage core.
- D. Terminal Connections and Protrusions: Cover all terminal edges with the integral fabric flap by tucking it around the edge of the core and securing it. At protrusions, cut the core around the

protrusion, cut an "X" in the fabric, and tape the fabric around the protrusion. Dirt and concrete must not infiltrate the core.

8. INSULATION INSTALLATION

- A. Install one (1) or more layers of insulation to achieve required thickness over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.
- B. On vertical surfaces, set insulation units in adhesive applied according to Manufacturer's instructions. Use type of adhesive recommended by insulation Manufacturer.
- C. On horizontal surfaces, place insulation units un-adhered according to Manufacturer's instructions. Stagger end joints and tightly abut insulation.

9. FIELD QUALITY CONTROL

- A. Test each deck area for leaks after waterproofing and before overlying construction is placed. Plug or dam drains and fill with water to a depth of two-inches (2") or to within three-inches (3") of top of sheet flashing, or less based on load capacity of deck. Flood each area for minimum 24 hours.
- B. Contractor will engage an independent testing agency to perform field inspections, sample and test materials being used, observe flood tests, and report whether tested Work conforms to or deviates from requirements.
 - 1. Testing agency will identify, seal, and certify samples of materials delivered to Project site, with Contractor present.
 - 2. Testing agency will perform tests for any of the product characteristics specified, using referenced test procedures and other tests cited in manufacturer's Product Data.
 - 3. Testing agency will verify thickness of waterproofing membrane.
 - 4. Testing agency will examine underside of decks and terminations for evidence of leaks.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.
 - 1. After flood tests, repair leaks and make further repairs until the waterproofing installation is watertight.
- D. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with requirements.

10. CURING, PROTECTING, AND CLEANING

- A. Cure waterproofing according to manufacturer's recommendations, taking care to prevent contamination and damage during application stages and curing.
 - 1. Do not permit traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 072616 – BELOW-GRADE VAPOR RETARDERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Heavy-duty under-slab plastic vapor retarder.

1.3 RELATED SECTIONS

- A. Appendix A – Geotechnical Report.
- B. Appendix D - Soil Handling and Contamination Mitigation Recommendations.

1.4 DEFINITIONS

- A. Vapor Retarder Assembly: The collection of vapor retarder materials and auxiliary materials applied over soil substrate, including the sealing of sheet laps, joints, and penetrations, forming an impermeable membrane to control movement of moisture up through slabs-ongrade.

1.5 ACTION SUBMITTALS

- A. Product Data: Provide data indicating material characteristics, performance criteria, and limitations.
- B. Shop Drawings: Submit shop drawings approved by manufacturer for site-specific detail conditions. Include details for flashing tie-ins, penetrations, and other termination conditions.
- C. Samples: Provide sample of each sheet and accessory material specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Manufacturer's Installation Instructions: Indicate preparation and installation requirements, techniques.
- B. Certificates of Compliance: Include the name, description of the product. Provide third Party independent testing reports to verify compliance with referenced standards.
 - 1. When Certificates of Compliance cannot be provided, the Contractor shall hire a professional testing laboratory to verify compliance. Contractor shall pay for the cost of testing.

1.7 CLOSEOUT SUBMITTALS

- A. Warranty: Executed special warranty specified in this Section.

1.8 QUALITY ASSURANCE

- A. Perform Work in accordance with ASTM E1643 and manufacturers recommend methods.
- B. Installer Qualifications: A qualified installer who employs on Project personnel qualified to install vapor barrier/retarder.
- B. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents: ACI 301, "Specification for Structural Concrete," Sections 1 through 5.
- D. Single-Source Responsibility: Obtain vapor retarder material and installation accessories from single source providing consistent quality in performance and appearance without delaying progress of the Work.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect vapor retarder materials from puncture damage prior to use.
- B. Comply with manufacturer's written recommendations for handling and storage, and protection during installation.

1.10 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to replace vapor retarder material that does not comply with requirements or that fails achieve a watertight seal, or exhibits loss of adhesion or cohesion within specified warranty period.
 - 1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide continuous vapor retarder under floor slab throughout the building, unless Indicated otherwise on Drawings and ASTM E1643.
- B. Vapor barrier shall have all of the following qualities:
 - 1. Maintain permeance of less than 0.01 Perms (grains/(ft² · hr · inHg)) as tested in accordance with mandatory conditioning tests per ASTM E1745 Section 7.1 (7.1.1- 7.1.5).
 - 2. Other performance criteria:
 - a. Strength: ASTM E1745 Class A.
 - b. Thickness: 15 mils minimum
 - 3. Provide third party documentation that all testing was performed on a single Production roll per ASTM E1745 Section 8.1.
 - 4. Puncture Resistance, ASTM D1709, Method B: 3,000 grams
 - 5. Tensile Strength, ASTM E154, Section 9: 67 lbf / in.

6. Water Vapor Permeance, ASTM F1249: 0.1 perms.

2.2 MATERIALS

- A. Plastic Vapor Retarder Sheeting: ASTM E1745, Class A, 15.0 mil total thickness, 14'-0" wide sheets.
 - 1. Basis-of-Design: Stego Industries; StegoWrap15-mil Class A.
 - 2. Fortifiber Corporation; Moistop Ultra A.
 - 3. Meadows, W.R., Inc.; Vapor Mat 15.
 - 4. Raven Industries Inc.; Vapor Block 15.
- B. Granular Fill: Clean mixture of crushed stone or crushed or uncrushed gravel; ASTM \ D448, Size 57, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.
- C. Fine-Graded Granular Material: Clean mixture of crushed stone, crushed gravel, and manufactured or natural sand; ASTM D448, Size 10, with 100 percent passing a 3/8-inch sieve, 10 to 30 percent passing a No. 100 sieve, and at least 5 percent passing No. 200 sieve; complying with deleterious substance limits of ASTM C 33 for fine aggregates.

2.3 ACCESSORIES

- A. Tape: Polyethylene pressure sensitive, self-adhering type, mesh reinforced, 4-inch wide, compatible with vapor retarder material.
 - 1. Perimeter Tape: Stego Industries; Crete Claw.
 - 2. Lap Tape: Stego Industries; Stego Tape.
 - 3. Penetration Tape: Stego Industries; Stego Mastic.
 - 4. Water Vapor Transmission Rate: ASTM E96/E96M; 0.3 perms or lower.
- B. Adhesive: Compatible with vapor retarder and substrate, permanently non-curing; as manufactured by vapor retarder manufacturer, with demonstrated capability to bond vapor retarders securely to substrates indicated.
 - 1. Water Vapor Transmission Rate: ASTM E96/E96M; 0.3 perms or lower
- C. Pipe Boots: Solid 15 mill pre-manufactured peel and stick patching product with aggressive all-weather adhesive for direct adhesion to vapor retarder surface, pipes and penetrations.
 - 1. Water Vapor Transmission Rate: ASTM E96/E96M; 0.0016 perms or lower
- D. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.
- E. Sealant and Cleaner for Vapor Retarder: As recommended by vapor retarder manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify required condition of substrate and adjacent construction with installer present. Make any corrections before proceeding with vapor retarder installation.
- B. Do not proceed with installation of retarder until unsatisfactory conditions have been corrected. Proceeding with installation indicates acceptance of substrate.

3.2 PREPARATION

- A. Remove loose or foreign matter that might impair adhesion.
- B. Level and tamp or roll aggregate, sand or tamped earth base. Ensure that subsoil is approved by CITY ENGINEER.
- C. Clean and prime substrate surfaces to receive adhesive in accordance with manufacturers' instructions.

3.3 INSTALLATION

- A. Install vapor retarder materials in accordance with manufacturer's instructions and ASTM E1643 requirements.
- B. Lay vapor retarder over base rock with width of sheet running parallel with the direction of concrete pour.
- C. Lap vapor retarder 6 inches minimum and seal with 4-inch wide adhesive tape. Position lap seals over firm bearing. Tape joints.
- D. Lap vapor retarder 3 inches over footings and grade beams. Seal membrane to concrete with adhesive or concrete nail every 5 foot on footing surface.
- E. Offset intermediate end joints in adjacent sheets no less than 4 feet.
- F. Cut sheeting to fit closely and neatly around penetrations of pipe and conduit. Seal tears and punctures.
- G. Slip sheeting over penetrations where possible, otherwise slit from penetration hole to nearest edge.
- H. Slip pipe boots fabricated from sheeting material over penetration holes and tape in place completely.
 - 1. Single pipe penetrations may be sealed using pipe boot constructed from the product. Cut a piece of plastic 12-inches wide x 1-1/2 times the circumference of the pipe. With scissors, cut slits half the width of the film. Wrap boot around pipe; tape onto pipe and completely tape the base to the vapor barrier.
 - 2. Multiple pipe penetrations in close proximity and very small pipes shall be sealed using mastic. Cut out a small area around pipes. Cut a patch of vapor barrier extending at least 6-inches past the cut out in all directions. Cut X's or small circles in the patch and install over pipes. Overlap at least 6-inches and tape. Build up 40- to 60-mils of mastic or as required to completely fill voids between the pipe and the vapor barrier.
- I. Seal penetrations of pipe and conduit with tape to ensure an airtight seal. Seal tears and punctures with tape immediately before proceeding with covering the vapor retarder. Use a second layer of vapor retarder material where damage to vapor retarder is extensive and would require excessive use of tape to repair.
 - 1. No penetration of the vapor retarder is allowed except for reinforcing steel and permanent utilities.
 - 2. Repair damaged areas by cutting patches of vapor retarder, overlapping damaged area 6 inches and taping all four sides with tape.
- J. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.

3.4 CLEANING

- A. Construction Waste Management: Manage construction waste in accordance with

provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

- B. PROTECTION
- C. Protect installed vapor retarders from damage by harmful weather exposure, and other construction activities.
- D. Repair any punctures to vapor retarder before pouring concrete slab over retarder.
- E. Do not permit adjacent Work to damage Work of this Section.

END OF SECTION 072616

SECTION 07 60 00 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Metal flashings of the following types:
 - 1. Metal flashing and counter flashings.
 - 2. Exposed metal trim/fascia units.
 - 3. Reglets.
 - 4. Copings.
 - 5. Roof drainage components including scuppers, downspouts, and splash pans.
 - 6. Through-wall flashings.
 - 7. Preformed flashing sleeves.
 - 8. Equipment support flashings.
- B. Miscellaneous sheet metal accessories.

1.3 RELATED SECTIONS

- A. Section 075419 – Polyvinyl Chloride (PVC) Roofing.
- B. Section 092400 - Portland Cement Plaster, 3-Coat Stucco.

1.4 DEFINITIONS

- A. Steel Sheet Thicknesses: Thickness dimensions, are minimums as defined in referenced ASTM standards for metallic-coated (galvanized) steel sheets. Metal thicknesses indicated below correspond to former gauge thicknesses:
 - 1. 16 Gauge: 0.053-inch (1.3-mm).
 - 2. 18 Gauge: 0.042-inch (1.0-mm).
 - 3. 20 Gauge: 0.040-inch (1.02-mm).
 - 4. 22 Gauge: 0.034-inch (0.85-mm).
 - 5. 24 Gauge: 0.028-inch (0.71-mm).
 - 6. 26 Gauge: 0.022-inch (0.55-mm).

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Describe material profiles, jointing pattern, jointing details, fastening

methods, interface with other work and installation details.

1. Material.
2. Thickness of material.
3. Weight.
4. Finish.
5. Location of each item and details of expansion joint covers, including the direction of expansion and contraction.

1.6 QUALITY ASSURANCE

- A. Conform to profiles and sizes shown on drawings, and comply with "Architectural Sheet Metal Manual" by SMACNA, for each general category of work required.
- B. Applicator: Applicator who has complete sheet metal flashing and trim work similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance and with 5 years minimum experience.
- C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
 1. Meet with CITY ENGINEER, CITY's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 2. Review methods and procedures related to sheet metal flashing and trim.
 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.
- D. Mock-ups: Build mock-ups to demonstrate aesthetic effects and set quality standards for fabrication and installation. Build mock-ups approximately 48-inches long, including supporting construction cleats, seams, attachments, underlayment, and accessories. Do not proceed with the installation until the mock-ups are approved by the CITY ENGINEER in writing.
 1. Approved mock-ups may become part of the completed work if undisturbed at the time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.
- B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.
- C. Stack materials on platforms or pallets, covered with a suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.
- B. Fabricate and install flashings and copings capable of resisting forces for the appropriate wind zone, per Factory Mutual's Loss Prevention Data Sheet 1-49.
- C. Temperature Range: 120 deg F ambient; 180 deg F, material surface.
- D. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the maximum range of ambient and surface temperatures provided above by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of sealant joints, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculations on surface temperatures of materials due to both solar heat gain and nighttime sky heat loss.
- E. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to the building interior.
 - 1. Watertight and weatherproof performance of flashing and sheet metal work is required.

2.2 MATERIALS

- A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Z275) coating designation; structural quality, mill phosphatized where indicated for field painting.
 - 1. Do not apply an acrylic passivator coating to galvanized sheet metal scheduled to be painted, or remove this coating mechanically before delivery to the project site.
 - 2. Prime all surfaces of bonderized metal.
 - 3. Finish: Standard (dull) mill finish; painted unless noted otherwise on Drawings.
 - 4. Paint: Paint sheet galvanized sheet metal that is not coil-coated.
- B. Bedding Compound: Rubber-asphalt type.
- C. Plastic Cement: Asphaltic base cement.
- D. Solder:
 - 1. For Zinc-Coated (Galvanized) Steel Sheet: ASTM B32, Grade Sn50, 50 percent tin and 50 percent lead or Grade Sn60, 60 percent tin and 40 percent lead.
- E. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide elastic, non-sag, nontoxic, non-staining tape.
- F. Sealant: Type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight; see Section 079200.
- G. Flux: FS O-F-506.
- H. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- I. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- J. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

- K. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
 - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
 - 2. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329 or Series 300 stainless steel.
 - 3. Fasteners for Zinc Sheet: Hot-dip galvanized steel according to ASTM A153/A153M or ASTM F2329 or Series 300 stainless steel.
- L. Sheet Membrane Underlayment at Flashings: Self-adhered, cold-applied composite rubberized asphalt sheet membrane consisting of rubberized asphalt bonded to a crosslaminated high-density polyethylene film with primers and seam sealers as required for a complete watertight installation; provide materials compliant with applicable regulations limiting VOCs.
 - 1. Under Sheet Metal and Flashing: Minimum 40-mil thick, high temperature selfadhering, polymer-modified, bituminous sheet membrane, complying with ASTM D1970/D1970M, manufacturers and types as follows:
 - a. GCP Applied Technologies: Grace Ice and Water Shield HT or Grace Ultra.

2.3 MANUFACTURED SHEET METAL FLASHING AND TRIM

- A. Reglets: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces, and compatible with flashing indicated.
 - 1. Acceptable Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Fry Reglet Corporation.
 - b. Heckmann Building Products, Inc.
 - c. Accepted equivalent.
 - 2. Material: Aluminum, 0.024-inch thick.
 - 3. Surface-Mounted Type: Provide with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers and with channel for sealant at top edge.
 - 4. Accessories:
 - a. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where Drawings show reglet without metal counterflashing.
 - b. Counterflashing Wind-Restrain Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing's lower edge.
 - c. Finish: Mill
- B. Drawbands: Stainless steel.

2.4 WINDOW AND STOREFRONT FLASHINGS

- A. Flashing for aluminum components that are integral to the windows or storefront framing:
 - 1. Aluminum, .090 minimum thickness, pre-finished where flashing is exposed to view.
 - 2. Flashing for other Aluminum Components: Aluminum, .040 minimum thickness, prefinished where flashing is exposed to view.
 - 3. Flashing for Steel Components/Penetrations: Hot dipped galvanized steel, 24 gauge minimum, pre-finished or field painted.
- B. Sill Pans: Fabricate to profiles indicated and to provide proper water drainage at window and door openings. Include 1-inch end dams and 1/2-inch minimum upturn at all pans, typical. Fabricate discontinuous lintel, sill, and similar flashings to extend 6-inches (150 mm) beyond each side of wall openings.
 - 1. Galvanized Steel: 0.0276-inch (0.7 mm) thick, painted black.

2.5 FABRICATION

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop-fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.
- B. Fabricate sheet metal with flat-lock seams; solder with type solder and flux recommended by manufacturer, except seal aluminum seams with sealant and, where required for strength, rivet seams and joints.
- C. Fabricate sheet metal flashing and trim in thickness and weight needed to comply with performance requirements, but not less than that specified for each application of metal.
- D. Fabricate corners, transitions, and terminations as a single unit; extend a minimum of 4-inches and a maximum of 8-inches in any direction.
- E. Fabricate cleats and attachment devices from the same material as the accessory being anchored or from a compatible, non-corrosive metal. The thickness of these cleats and attachment devices should be as recommended by SMACNA's 'Architectural Sheet Metal Manual' and Factory Mutual's Loss Prevention Data Sheet 1-49 for the given application, but not less than the thickness of the metal being secured.
- F. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.
- G. Coat backside of fabricated sheet metal with 15-mil sulfur-free bituminous coating, SSPCPaint 12, where required to separate metals from corrosive substrates, including cementitious materials, wood or other absorbent materials; or provide other permanent separation.
- H. Provide for thermal expansion of running sheet metal work by overlaps of expansion joints in fabricated work. Where required for watertight construction, provide hooked flanges filled with polyisobutylene mastic for 1-inch embedment of flanges.
- I. Space expansion joints at intervals of not more than 50-feet. Conceal expansion provisions where possible.
- J. Roof-Penetration Flashing: Fabricate from the following material:
 - 1. Galvanized Steel: 0.0276-inch (0.7 mm) thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

- A. Roof Edge Flashing (Gravel Stop) and Fascia Caps: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide joint cover plates.
 - 1. Galvanized Steel: 0.028 inch (0.71 mm)
- B. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate 1-inch drive joints at the coping joints 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, seal, and solder or weld watertight.
 - 1. Joint Style: Butted with expansion space and 6-inch-sided, concealed backup plate.
 - 2. Vertical Face of Copings: Bottom edge formed outward 1/4- to 1/2-inch, hemmed to form a drip.
 - 3. Coping Profile: As indicated on Drawings.
 - 4. Galvanized Steel: 0.040 inch (1.02 mm).
 - 5. Finish: Painted
- C. Base Flashing: Shop-fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Galvanized Steel: 0.028 inch (0.71 mm)
- D. Counterflashing: Shop-fabricate interior and exterior corners. Fabricate from the following materials:
 - 1. Galvanized Steel: 0.022 inch (0.56 mm)
- E. Flashing Receivers: Fabricate from the following materials:
 - 1. Galvanized Steel: 0.022 inch (0.56 mm).
- F. Roof-Penetration Flashing: Fabricate from the following materials:
 - 1. Galvanized Steel: 0.028 inch (0.71 mm)
- G. Roof-Drain Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.016 inch (0.40 mm) thick.

2.7 WALL SHEET METAL FABRICATIONS

- A. Through-Wall Flashing: Fabricate continuous flashings in maximum 96-inch- (2400-mm-) long sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6-inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high end dams where flashing is discontinuous.
 - 1. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
 - 2. Fabricate through-wall flashing with sealant stop, unless otherwise indicated. Fabricate by bending metal back on itself 3/4-inch (19 mm) at exterior face of wall and down into joint 3/8-inch (10 mm) to form a stop for retaining sealant backer rod.
 - 3. Metal Flashing Terminations: Fabricate from galvanized steel. At exterior face of wall, bend metal back on itself for 3/4-inch (19 mm) and down into joint 3/8-inch (10 mm) to form a stop for retaining sealant backer rod.
 - 4. Fabricate from one of the following:
 - a. Galvanized Steel: 0.022 inch (0.56 mm) thick.
 - b. Aluminum: 0.032 inch (0.81 mm) thick.
 - c. Aluminum-Zinc Alloy-Coated Steel: 0.022 inch (0.56 mm) thick.

2.8 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Paint all exposed flashings throughout except those that are coil coated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which sheet metal flashing and trim are to be installed and verify that work may properly commence. Do not proceed with installation until unsatisfactory conditions have been corrected. Beginning of installation means acceptance of existing conditions.
- B. Ensure that adjacent work by other trades has been completed as required and as shown on the Drawings.

3.2 PREPARATION

- A. Allow wet substrates to dry thoroughly.
- B. Clean debris from all substrates.

3.3 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.
- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.4 INSTALLATION

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
 - 1. Torch cutting of sheet metal flashing and trim is not permitted.
- B. Anchor work in place with non-corrosive fasteners, adhesives, setting compounds, tapes and other materials and devices as recommended by manufacturer of each material or system.
- C. Install self-adhesive flashing prior to or in conjunction with sheet metal items, as shown on Drawings.
- D. Provide for thermal expansion and building movements. Comply with recommendations of "Architectural Sheet Metal Manual" by SMACNA.
- E. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
- F. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

- G. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
- H. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
- I. Composition Stripping: Cover flanges (edges) of work set on bituminous substrate with 5 courses of glass fiber fabric (ASTM D1668/D1668M) set in and covered with asphaltic roofing cement.
- J. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4-inches (32mm) for nails and not less than 3/4-inch (19 mm) for wood screws.
 - 1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.
 - 2. Use concealed fasteners wherever possible. Exposed fasteners should have bonded neoprene washers or should be sealed.
- K. Seal moving joints in metal work with butyl joint sealants, complying with requirements specified in Section 079200 as required for watertight construction.
 - 1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1-inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealanttype joints at temperatures below 40 deg F (4 deg C).
- L. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2-inches (38 mm) except where pre-tinned surface would show in finished Work.
 - 1. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.
 - 2. Clean metal surfaces of soldering flux and other substances that could cause corrosion.

3.5 ELASTOMERIC SHEET MEMBRANE COUNTERFLASHING INSTALLATION AT PENETRATIONS

- A. Surface Preparation:
 - 1. Remove oil, grease, scale, paint dust, corrosion products, and any other materials that may affect the adhesive bond of the elastomeric sheet membrane.
 - 2. Etch concrete, masonry, and metal surfaces with 10% muriatic acid.
- B. Apply primer to clean, dry surface immediately after surface preparation.
 - 1. Allow to dry 2 hours minimum.
 - 2. Do not apply primer to membrane.
 - 3. Install bond breaker tape centered over joint between penetration and top edge of flashing collar.
- C. Renew primer if over 24 hours elapses before application of adhesive.
- D. Application of Adhesive:
 - 1. Apply two even brush coats of adhesive to substrate.

2. Allow 15 minutes drying time between coats.
3. Apply one full coat of adhesive to membrane sheet.
4. Minimum drying times:
 - a. Allow sufficient adhesive drying to take place to prevent trapping of solvents in the adhesive, which causes significant weakening of bond strength.
 - b. Minimum drying times have been observed to range between 10 minutes in warm, dry weather (90 def F, 10% relative humidity), to 1/2 hour in colder weather.
 - c. Do not attempt joining coated surfaces during the drying time.
 - d. Form bonds after adhesive becomes dull, and while still sticky.
 - e. If adhesive is 'open' too long before joining coated surfaces, the membrane will no longer adhere to substrate; reactive adhesive by applying an additional full coat of adhesive.
- E. Joint Coated Surfaces:
 1. Elastomeric sheet membrane may be stretched during placement, to 1% to 2% elongation in final position, to conform to various contours, without undo stress to membrane during placement, and without damage to cured membrane.
 2. Provided a plastic or clot liner is used, membrane may be rolled or folded; use caution as adhesive coated surfaces bond readily to uncoated membrane surfaces.
 3. Apply sheet by unrolling or otherwise placing in position and flattening with the hand to prevent air entrapment.
 4. Do not work too large an area at a time.
 5. Roll all of the area with a steel flat face roller.
 6. 'Stitch' all edges, corners and laps using a 2-inch x 1/4-inch knurled hand stitcher and stiff pressure.
 7. Overlap edges a minimum of 3-inches and end joints 6-inches in such a way as to shed water.
 8. At all edge intersections of laps including inside or outside corners, apply a fillet of membrane sealant.
- F. Application of Color Coating: Apply adhesive to elastomeric sheet membrane and allow to dry as described above.
 1. Coat elastomeric membrane with U66A to provide a 15 mil dry film thickness.

3.6 ROOF FLASHING INSTALLATION

- A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual". Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with claps, joints, and seams that will be watertight.
- B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to 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 (75-mm) centers.
- C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4-inches (100 mm) over base flashing. Lap counterflashing joints

- a minimum of 4-inches (100 mm) and bed with elastomeric sealant.
- D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4-inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.
 - E. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.
 - 1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
 - 2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 24-inch (600-mm) centers.
 - 3. Do not cover scupper overflows with copings.
 - F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof.
 - 1. Seal with elastomeric sealant and clamp flashing to pipes penetrating roof. Use stainless steel drawband and tighten.
 - 2. Install premanufactured membrane flashing a minimum of 8 inches up vent piping and over base roof membrane, being careful not to block vent piping with flashing. Seal flashing to base roof membrane where required by roofing manufacturer.
 - 3. Seal top of membrane flashing with elastomeric sealant and clamp flashing to pipes with stainless steel drawband.

3.7 WALL FLASHING INSTALLATION

- A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.
- B. Through-Wall Flashing: At plaster walls, extend flashing through plaster system, across air space behind plaster, and up face of sheathing at least 8-inches (200 mm); with upper edge tucked under building paper or building wrap, lapping at least 4-inches (100 mm).
 - 1. Install metal sealant stops with sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 for application indicated.

3.8 ADJUSTING

- A. 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.

3.9 CLEANING

- A. Clean and neutralize flux materials. Clean off excess solder and sealants.
- B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.
- C. Construction Waste Management: Manage construction waste in accordance with

provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

END OF SECTION 076000

SECTION 07 92 00- JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Exterior Joints in Vertical Surfaces and Horizontal Non-traffic Surfaces:
 - 1. At flashing and sheet metal.
 - 2. Construction joints in cast-in-place concrete.
 - 3. Perimeter joints around frames of storefronts, doors, windows, and louvers.
- B. Interior Joints in Vertical Surfaces and Horizontal Non-traffic Surfaces:
 - 1. Control and expansion joints on exposed interior surfaces of exterior walls.
 - 2. Perimeter joints of exterior openings.
 - 3. Tile control and expansion joints.
 - 4. Vertical joints on exposed surfaces of concrete walls and partitions.
 - 5. Interior rated and non-rated sealants.
 - 6. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - 7. Perimeter joints between plumbing fixtures and adjoining walls, floors, and counters.
 - 8. Control and expansion joints in ceiling and overhead surfaces.
 - 9. Acoustical joints in wall and ceiling surfaces.
- C. Interior Joints in Horizontal Traffic Surfaces:
 - 1. Isolation joints in cast-in-place concrete slabs.
- D. Joint sealant primers and accessories.

1.3 RELATED SECTIONS

- A. Section 076000 - Flashing and Sheet Metal.
- B. Section 078400 - Firestopping: Sealing of perimeter joint and through-wall penetrations.
- C. Section 088100 – Glass Glazing: Sealants used in glazing.
- D. Section 092900 - Gypsum Board: Sealing concealed perimeter joints of gypsum board partitions to reduce sound transmission.

1.2 ACTION SUBMITTALS

- A. Product Data: Manufacturer's technical data for each product required, including instructions for joint preparation and sealant application. Include certification by joint

sealant manufacturer that sealants, primers, and cleaners comply with local regulations controlling the use of volatile organic compounds (VOC).

1. Include tested physical and performance properties. Include data sheets for substrate cleaners and substrate primers recommended by sealant manufacturer for specific substrate surface conditions.
- B. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- (13-mm-) wide joints formed between two 6-inch- (150-mm-) long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
 1. Submit 2 copies of manufacturer's standard color chart with physical samples of each color. Submit information on availability of custom colored sealants.
- C. Joint Sealant Schedule: Include the following information:
 1. Joint sealant application and typical joint locations to receive sealants.
 2. Joint sealant manufacturer and product name.
 3. Joint sealant formulation and color.

1.3 INFORMATIONAL SUBMITTALS

- A. Certification by joint sealant manufacturer that sealants plus the primers and cleaners required for sealant installation comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Submit manufacturer's letter of certification that products comply with specified requirements and are suitable for the uses intended.
- C. Product Test Reports:
 1. Certified test results of elastomeric sealants showing compliance with specified requirements. Include results of aged performances including hardness, stainresistance, adhesion and cohesion under cyclic movement, low temperature flexibility, modulus of elasticity at 100-percent strain, effects of heat and aging, and effects of accelerated weathering.
 2. Preconstruction field test results indicating which products and joint preparation methods demonstrated acceptable adhesion to joint substrates.
- D. Qualification Data: For Installer.
- E. Warranties: Samples of special warranties.

1.4 CLOSEOUT SUBMITTALS

- A. Warranties: Executed special warranties specified in this Section.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Provide to the CITY ENGINEER an inventory for use in annual inspections and to allow for proper repair, restoration or replacement where rated materials and assemblies have been damaged, altered, breached or penetrated during the previous year, including:
 1. Fire-resistive joint systems.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

- B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
 - 1. Ensure that sealants selected are compatible with and will adhere to all surfaces with which they are to be in contact.
- C. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the Work.
 - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C1021 to conduct the testing indicated, as documented according to ASTM E548.
 - 2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C920, and where applicable, to other standard test methods.
- D. Sealant manufacturer shall confirm in writing that all materials contacting the sealants, including joint backings, gaskets, spacers, and joint substrates, are compatible with the sealant to be installed. Schedule sufficient time to test these materials for compatibility with the sealant, as necessary. Compatibility tests shall be performed to the sealant manufacturer's standards.
 - 1. Determine if priming and/or other preparation techniques are required.
 - 2. Determine compatibility of exterior joint sealant with stone material to be used. Verify that joint sealant oils do not migrate onto stone face causing visual banding while wet or dry. Manufacturer shall perform staining tests of sealant systems in accordance with ASTM C510 and ASTM D2203 methods for each joint substrate condition in the work.
 - 3. Testing for adhesion is not required if sealant manufacturer has performed previous testing of proposed sealants for adhesion to and compatibility with required joints substrates.
- E. Sealant manufacturer shall confirm in writing the appropriate joint preparation and priming techniques required to obtain rapid, acceptable adhesion of the joint sealants to the joint substrates.
- F. Preconstruction Field Testing: Prior to installation of joint sealants, field-test adhesion to all joint substrates and surface types. Field adhesion testing shall be completed and results shall be reviewed and approved by sealant manufacturer and installer before commencing sealant installation.
 - 1. Install joint sealants in 5-foot joint lengths. Allow to cure before testing. Test adhesion by pulling sealant out of joint according to "Method A, Field-Applied Sealant Joint Hand Pull Tab", in Appendix X1 in ASTM C1193. 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.
 - 2. Perform field tests for each type of elastomeric sealant and joint substrate.
 - 3. Arrange for tests to take place with joint sealant manufacturer's technical representative present.
 - 4. Report whether or not sealant in joint connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each type of product and joint substrate.
 - 5. 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 substrate during testing.

- G. Pre-Installation Meeting: Review joint application procedures, compatibility tests, adhesion tests, and warranty requirements in a meeting involving installer, manufacturer or manufacturer's representative, CITY ENGINEER, consultant, and contractor.
- H. Mockup: Build mockup incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:
 - 1. Joints in mockup of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials intact and legible.
- B. Store and handle materials in compliance with manufacturer's recommendations to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.8 SITE CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:
 - 1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturer.
 - 2. Below 40 deg F (4.4 deg C).
 - 3. When joint substrates are wet or retaining moisture.
- B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer's standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Exterior Sealants: Furnish a written warranty against leaks or other defects of materials, fabrication, and installation. Defects include but are not limited to changes in the structural, physical or chemical properties of the sealant materials that impair function or require abnormal maintenance, changes in surface finish, color or texture, failure in adhesion or cohesion, weather resistance or durability, failure to prevent entry of water, do not cure, or failure to comply with specified requirements.
 - 1. This warranty shall not cover formation of cracks or defects in substrate materials adjacent to the seal, joint movement in excess of movement rating of sealant, or physical damage caused by others.

2. Repair or replace defective materials, fabrication, and installation during warranty period without expense to CITY ENGINEER, including removal and replacement of other items as required.
 3. This warranty shall be in addition to and not a limitation of other rights the CITY ENGINEER may have against the Contractor under the Contract Documents.
 4. Warranty Period: Ten years from date of Substantial Completion.
- C. Special Manufacturer's Warranty: Manufacturer's standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- D. Failure of the materials, fabrication, and installation include leakage, hardening, cracking, crumbling, melting, shrinkage or running of the sealant or caulking, or the staining of adjacent materials.
- E. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
 2. Disintegration of joint substrates from natural 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 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.
- B. Provide joint sealants for interior applications that establish and maintain airtight and waterresistant continuous joint seals without staining or deteriorating joint substrates.

2.3 MATERIALS

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by CITY ENGINEER from manufacturer's full range.
- C. Provide selections made by CITY ENGINEER from manufacturer's full range of standard colors for products of type indicated.

2.4 EXTERIOR JOINT SEALANTS

- A. Exterior Silicone Weatherproofing and Control Joint Sealant: ASTM C920, also ASTM C1193 and tested under ASTM C719; Type S, Grade NS, Class 100/50, Use NT, M, G, A, and O; single component, low-modulus, non-sag sealant, use at exterior joints in vertical surfaces and non-traffic horizontal surfaces such as but not limited to:
 - 1. Butt joints between metal panels.
 - 2. Perimeter joints between materials listed above and frames of doors, windows, storefronts, louvers, and similar openings.
 - 3. Control and expansion joints in ceilings and overhead surfaces.
 - 4. Other exterior joints in vertical surfaces and non-traffic horizontal surfaces for which no other sealant is specified.
 - 5. Acceptable Sealants:
 - a. Dow Corning Corporation; Dow Corning 790.
 - b. Pecora Corporation; 890.
 - c. Tremco; Spectrem 1.
- B. Reglets and Flashings Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, A, and O; single component elastomeric.
 - 1. Acceptable Sealants:
 - a. Dow Corning Corporation; Dow Corning 795.
 - b. Pecora Corporation; 895NST.
 - c. Tremco, Inc.; Spectrem 2.
- C. Weather Barrier Sealant: ASTM C920, Type S, Grade NS, Class 25, neutral-cure, singlecomponent elastomeric; ASTM C719 +/- 25 movement.
 - 1. Acceptable Sealants:
 - a. Dow Corning Corporation; Dow Corning 758.
- D. Concrete Walkway Joint Sealant: Single-Component, Nonsag, Traffic-Grade, Neutral-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 100/50, for Use T.
 - 1. Acceptable Sealants:
 - a. Dow Corning Corporation; Dow Corning 790.
 - b. Pecora Corporation; 301 NS.
 - c. Tremco Incorporated, Spectrem 800.

2.6 INTERIOR JOINT SEALANTS

- A. Interior Weatherproofing and Control Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G, A, and O; single component, chemical curing, non-staining, non-bleeding, non-sagging type; color as selected; use in interior surfaces such as, but not limited to:
 - 1. Control and expansion joints on exposed interior surfaces of exterior walls.
 - 2. Perimeter joints on exposed interior surfaces of exterior openings.
 - 3. Joints on precast beams and planks.
 - 4. Perimeter joints between interior wall surfaces and frames of interior doors, windows, storefronts, louvers, elevator entrances and similar openings.
 - 5. Other interior joints in vertical surfaces and non-traffic horizontal surfaces subject to movement for which no other sealant is specified.
 - 6. Acceptable Sealants:

- a. Pecora Corporation; Dynatrol I-XL.
 - b. Sika Corporation, Inc.; Sikaflex 1a.
 - c. BASF (Sonneborne); NP 1.
 - d. Tremco; Dymonic FC.
- B. Interior Latex Joint Sealant: Provide product complying with ASTM C834, Type S, Use O, Grade NS; use at interior joints in vertical surfaces and non-traffic horizontal surfaces such as, but not limited to:
 1. Perimeters of interior door and window frames.
 2. Interior wall surfaces scheduled to receive latex paints.
 3. Control and expansion joints on exposed interior surfaces of exterior walls.
 4. Perimeter joints on exposed interior surfaces of exterior openings.
 5. Joints on precast beams and planks.
 6. Perimeter joints between interior wall surfaces and frames of interior doors, windows, storefronts, louvers, elevator entrances and similar openings.
 7. Trim or finish joints subject to movement.
 8. Acceptable Sealants:
 - a. Pecora Corporation; AC-20.
 - b. BASF (Sonneborn); Sonolac.
 - c. Tremco; Tremflex 834.
- C. Mildew Resistant Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25; Use NT, G, A, and O; use on non-porous interior surfaces under high humidity and temperature extremes. For use in the following:
 1. Bathrooms, spas, and similar applications where joints need protection against fungi and bacteria.
 2. Perimeters of plumbing fixtures.
 3. Acceptable Sealants:
 - a. Dow Corning Corporation; Dow Corning 786.
 - b. Pecora, Inc. 898.
 - c. Tremco, Inc Tremsil 200.
- D. Interior Food Contact Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT, G, A, and O; USDA compliant, for use at the following:
 1. Joints in kitchen countertops and work surfaces.
 2. Joints between food service equipment and surrounding construction.
 3. Other interior joints where incidental food contact may occur.
 4. Acceptable Sealants:
 - a. Pecora Corporation; 898.
 - b. BASF (Sonneborn); Omniplus.

2.7 ACOUSTICAL SEALANT

- A. Acceptable Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 1. Acoustical Sealant for Exposed and Concealed Joints:
 - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
 - b. USG Corporation; SHEETROCK Acoustical Sealant.
 2. Acoustical Sealant for Concealed Joints:
 - a. OSI Sealants, Inc.; Pro-Series SC-175 Rubber Base Sound Sealant.

- b. Pecora Corporation; BA-98.
 - c. Tremco, Inc.; Tremco Acoustical Sealant.
- B. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.
- C. Acoustical Sealant for Concealed Joints: Manufacturer's standard nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), recommended for sealing interior concealed joints to reduce airborne sound transmission.
- D. Acoustical Sealant for Exposed and Concealed Joints: Non-sag, paintable, nonstaining, latex sealant, with a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24), complying with ASTM C834 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90; use for drywall or plaster wall systems, bedding electrical boxes and other wall outlets.
 - 1. Acceptable Sealants: One of the following or approved equal:
 - a. Pecora Corporation; AC-20 Acoustical and Insulation Latex Sealant.
 - b. United States Gypsum Co.; SHEETROCK Acoustical Sealant.
 - c. Tremco, Inc.; Tremflex 834 or Tremco Acoustical Sealant.

2.8 JOINT SEALANT BACKING

- A. General: Provide sealant backings and accessory materials, including primers, of material and type that are non-staining; are compatible with joint substrates, sealants, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Foam Joint Fillers: Non-gassing, preformed, compressible, resilient, non-staining, nonwaxing, non-extruding strips of flexible plastic foam of one of materials indicated below, as recommended by manufacturer for compatibility with their sealant; of size, shape, and density to control sealant depth, prevent three-sided adhesion, provide a surface against which to tool, and otherwise contribute to producing optimum sealant performance:
- C. Foam Joint Fillers: Non-gassing, preformed, compressible, resilient, non-staining, nonwaxing, non-extruding strips of flexible plastic foam of one of materials indicated below, as recommended by manufacturer for compatibility with their sealant; of size, shape, and density to control sealant depth, prevent three-sided adhesion, provide a surface against which to tool, and otherwise contribute to producing optimum sealant performance:
 - 1. Cylindrical Sealant Backings: Of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance and as recommended by sealant manufacturer. Types:
 - a. Types: ASTM C1330:
 - 1) Type C: Non-gassing, closed-cell material with a surface skin.
 - 2) Type O: Cylindrical flexible sealant backings composed of

- predominantly open cell material.
- 3) Type B: Bicellular material with a surface skin.

2.9 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from pre-construction joint sealant/substrate tests and field tests. Certify that primer will not permanently stain adjacent joint surfaces.
- 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 in any way joint substrates and adjacent nonporous surfaces, and formulated to promote optimum adhesion of sealants with joint substrates.
- C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints, to mask off adjacent joint surfaces where sealant is not permanently intended to be applied.
- D. Bondbreaker Tape: Polyethylene pressure sensitive adhesive tape, to be used in areas where backer rod cannot fit and where three-sided adhesion is to be avoided.

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 joint sealant performance.
- B. Verify that joint sizes and surfaces are free of defects and acceptable for installation of joint sealants.
- C. Verify joint dimensions and shapes to ensure they are within the sealant manufacturer's guidelines. Resolve any variances prior to installation. Do not proceed with sealant installation until the unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Thoroughly clean the areas that the new sealant will contact using a de-greasing solvent not harmful to the environment using the two-rag wipe technique. IPA (isopropyl alcohol) is not a degreasing solvent. The new sealant should have a minimum contact area of 1/4".
- B. 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, blast cleaning, 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 oilfree compressed air. Porous joint substrates include the following:

- a. Concrete.
 - b. Masonry.
3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous 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 ceramic tile.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant 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 JOINT PRIMING

- A. Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on pre-construction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations.
- B. Confine primers to areas of joint sealant bond; do not allow spillage or migration onto adjoining surfaces.
- B. Allow primer to dry. Do not prime areas that cannot be sealed the same day.
- C.

3.4 INSTALLATION OF SEALANT BACKINGS

- A. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the 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 fillers.
 2. Do not stretch, twist, puncture, or tear joint fillers.
 3. Remove absorbent joint fillers that have become wet prior to sealant application and replace with dry material.
- B. Install joint backing to maintain the following joint ratios, but in no case less than 1/4 inch (6mm):
 1. Joints up to 1/2 inch wide: 1:1 width to depth ratio.
 2. Joints Greater than 1/2 inch wide: 2:1 width to depth ratio; maximum 1/2 inch joint depth.
 3. Sub-caulk joints that are deep, or joints without suitable backstop, to proper depth.
 4. Protect side walls of joint (to depth of caulking) with bond breaker tape.
 5. Install with adhesive on 2 faces in contact with sides of joints.

3.5 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint sealant manufacturer's printed installation instructions

applicable to products and applications indicated, except where more stringent requirements apply.

- B. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Installation of Sealants: Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability. Install sealants at the same time sealant backings are installed.
- E. Tooling of Non-sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to 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 configuration per Figure 5A in ASTM C1193, unless otherwise indicated.
 - 4. Provide flush joint configuration where indicated per Figure 5B in ASTM C1193.

3.6 CLEANING

- A. Clean off excess sealants and 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.
- B. Leave finished work in a neat, clean condition with no evidence of spillovers onto adjacent surfaces.
- C. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

3.7 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances or from damage resulting from construction operations or other causes so that they are without deterioration or damage at time of Substantial Completion.
- B. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so that and installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

DIVISION 08

Openings

SECTION 08 11 13- HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Standard steel doors and frames indicated and scheduled on Drawings.

1.3 RELATED SECTIONS

- A. Section 087100 - Door Hardware.
- B. Section 099100 – Painting: Finish painting of steel items.

1.4 DEFINITIONS

- A. Steel Sheet Thicknesses: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets. Metal thicknesses indicated below correspond to former gauge thicknesses:
 - 1. 20 Gauge: 0.032-inch (0.8-mm).
 - 2. 18 Gauge: 0.042-inch (1.0-mm).
 - 3. 16-gauge: 0.053-inch (1.3-mm).
 - 4. 14 Gauge: 0.067-inch (1.7-mm).
 - 5. 12 Gauge: 0.093-inch (2.3-mm).

1.6 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data substantiating that products comply with requirements.
- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - 1. Indicate dimensions and locations of mortises and holes for hardware.
 - 2. Indicate dimensions and locations of cutouts.
 - 3. Indicate doors to be factory finished and finish requirements.
 - 4. Show anchorage and other requirements.
 - 5. Indicate fire ratings for fire doors.

1.7 INFORMATIONAL SUBMITTALS

- A. Provide schedule of doors and frames using same reference numbers for details and openings as those on contract drawings.
- B. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.8 QUALITY ASSURANCE

- A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames", ANSI A250, and as specified herein.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage. Provide additional sealed plastic wrapping for factory finished doors.
- B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided refinished items are equal in all respects to new work and acceptable to CITY ENGINEER; otherwise, remove and replace damaged items as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4" high wood blocking. Avoid use of non-vented plastic or canvas shelters which could create humidity chamber. If cardboard wrapper on door becomes wet, remove carton immediately. Provide 1/4" spaces between stacked doors to promote air circulation.

1.10 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating custom steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.11 COORDINATION

- A. Coordinate installation of anchorages for custom steel frames. 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or approved equal:
 - 1. Allegion/ Republic Doors and Frames
 - 2. Allegion/Steelcraft Doors and Frames.

3. Assa Abloy/Ceco Door Products.
4. Assa Abloy/Curries Company.

2.2 STANDARD STEEL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
 1. Design: Flush panel.
 2. Non-Rated Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8.
 3. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 6.0 deg F x h x sq. ft./Btu (1.057 K x sq. m/W) when tested according to ASTM C 1363.
 - a. Locations: Exterior doors and interior doors where indicated.
 4. Fire Door Core Construction: As required to provide fire-protection ratings indicated.
 5. Vertical Edges, for Single- and Double-Acting Doors: Square edge.
 6. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick end closures or channels of same material as face sheets.
 7. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 1. Fabricate from galvanized steel sheet.
 2. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 1 (Full Flush) or Model 2 (Seamless) composite construction where indicated on Drawings.
 3. Material: Galvanized steel sheet, 16-gauge, 0.053-inch (1.3 mm) thick.
- C. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical-endurance level:
 1. Fabricate from cold-rolled steel sheet.
 2. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush) or Model 2 (Seamless) composite construction where indicated on Drawings.
 3. Material: Steel sheet, 0.042-inch (1.0 mm) thick.
 4. Cores: Manufacturer's standard as required for each type of rated and non-rated door and that meets rating requirements.

2.3 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from galvanized steel sheet.
 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 2. Frames for Level 1 and Level 2 Steel Doors: 16-gauge, 0.053-inch- (1.3-mm-) thick steel sheet.

3. Frames for Level 3 and Level 4 Steel Doors: 14-gauge, 0.067-inch- (1.7-mm-) thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
 2. Knocked-Down Frames: Not permitted.
 3. Frames for Level 1 and Level 2 Steel Doors: 16-gauge, 0.053-inch- (1.3-mm-) thick steel sheet.
 4. Frames for Level 3 and Level 4 Steel Doors: 14-gauge, 0.067-inch- (1.7-mm-) thick steel sheet.
 5. Frames for Wood Doors: 16-gauge, 0.053-inch- (1.3-mm-) thick steel sheet.
 6. Frames for Borrowed Lights: 16-gauge, 0.053-inch- (1.3-mm-) thick steel sheet.
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
 1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
 2. Pivots: Minimum 0.167 inch (4.2 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
 3. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 14-gauge, 0.067 inch (1.7 mm) thick.
 4. All Other Surface-Mounted Hardware: Minimum 14-gauge, 0.067 inch (1.7 mm) thick.
- E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- F. Jamb Anchors:
 1. Metal Stud Anchor: Z-type anchor, welded to frame, 16-gauge, 0.053-inch-thick steel, UL listed as required for fire rating.
- G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 1. Used at all frames installed prior to walls. Where frames are installed after walls, install an additional jamb anchor within the lowest 6-inches of the door jamb, one each side.
 2. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 3. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A653/A653M, with ASTM A924/A924M, G90 zinc coating, mill phosphatized.

- C. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A153/A153M, Class B.
- D. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A153/A153M.
- E. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- F. Glazing: Comply with requirements in Section 088100.

2.5 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.
- B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16mm) high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.6 FABRICATION

- A. Fabricate steel door and frame units to be rigid, neat in appearance and free from defects, warp or buckle. Wherever practicable, fit and assemble units in manufacturer's plant.
- B. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at project site.
- C. Hollow Metal Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
 - 3. Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from only cold-rolled steel. Install insulation in doors where scheduled on Drawings.
 - 4. Fabricate exterior doors, panels, and frames from galvanized sheet steel. Close top and bottom edges of exterior doors as integral part of door construction or by addition of minimum 16-gauge inverted steel channels. Seal joints watertight.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - a. All exterior frame joints shall be fully welded and watertight.
 - 2. 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 butt welding.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be

- grouted.
- 5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
- 6. Fabricate frames, concealed stiffeners, reinforcement, edge channels, louvers and moldings from cold-rolled or hot-rolled steel (at fabricator's option).
- 7. Provide 3/8-inch back bend return on frames where gypsum board wall material occurs whether on one or both sides.
- 8. Fabricate frames having multiple openings with mullion members having no visible seams or joints. Continuously weld face, rabbet, and soffit joints between abutted members and finish smooth when exposed to exterior.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
 - 1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
 - 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.
 - 4. Provide loose stops and moldings on inside of hollow metal work.
 - 5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
 - 6. Factory-install glass in prepared openings.
- F. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips heads for exposed screws and bolts. Paint heads to match adjacent surfaces.
- G. Finish Hardware Preparation: Prepare doors and frames to receive mortised and concealed finish hardware in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A115 series specifications for door and frame preparation for hardware.
 - 1. Locate finish hardware as indicated on final shop drawings or, if not indicated, in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.
 - 2. Prepare frames for silencers except for frames which receive weatherstripping.
 - 3. Provide dust cover boxes or mortar guards of 0.016-inch-thick steel at all hardware mortises on frames.
 - 4. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.
- H. Factory-install louvers in prepared openings.

2.7 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish standard steel door and frames after assembly.
- B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A780/A780M.

1. Galvanizing Repair Paint: High-zinc-dust-content paint for regalvanizing welds in steel, complying with SSPC-Paint 20.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. 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.
- E. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).
 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

2.8 ACCESSORIES

- A. Supports and Anchors: Fabricated from not less than 0.042-inch- (1.0-mm-) thick, electrolytic zinc-coated or metallic-coated steel sheet.
- B. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A153/A153M, Class C or D as applicable.
- C. Shop Applied Primer: Rust-inhibitive enamel or paint, air-drying or baking type, suitable as a base for specified finish paints.
- D. Door Silencers: Except on weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.
- E. Gaskets:
 1. Inner Gasket: Surface-mounted to inside of frame stop with compressible bulb to engage interior face of door at all four sides.
 2. Outer Gasket: Surface adhered to face of frame stop with silicone bulb and integral adhesive strip to engage interior face of door at all four sides.
- F. Finish: Paint in accordance with Section 099100.

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 steel doors and frames.
 1. Examine roughing-in for embedded and built-in anchors to verify actual locations of steel frame connections before frame installation.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Install standard steel doors, frames, and accessories in accordance with final shop drawings, manufacturer's data, and as herein specified.
- C. Placing Frames: Comply with provisions of ANSI A250.11 "Recommended Erection Instructions for Steel Frames", unless otherwise indicated.
- D. Except for frames located at in-place concrete and at drywall installations, place frames prior to construction of enclosing walls. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
- E. In metal stud partitions, install at least 3 wall anchors per jamb at hinge and strike levels. In open steel stud partitions, place studs in wall anchor notches and wire tie. In closed steel stud partitions, attach wall anchors to studs with tapping screws.
- F. Standard Steel Frames: Install standard steel frames for doors of size and profile indicated. Comply with ANSI A250.11.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. Install frames with removable glazing stops located on secure side of opening.
 - b. Install door silencers in frames before grouting.
 - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - d. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - e. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with post-installed expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
 - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
 - 4. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
 - 5. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal

- line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
 - G. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
 - 1. Non-Fire-Rated Standard Steel Doors:
 - a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
 - b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6mm).
 - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
 - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).
 - H. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.
 - 1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) oc, and not more than 2 inches (50 mm) oc from each corner.

3.3 ADJUSTING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying primer.

3.4 CLEANING

- A. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
- B. Galvanized Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- C. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

END OF SECTION 081113

SECTION 08 31 13 – ACCESS DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Interior access panels and doors in walls and suspended drywall ceilings.
- B. Exterior access panels in exterior soffits.

1.3 RELATED SECTIONS

- A. Section 099100 – Painting: Finish painting for metal surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: Indicate type(s) of doors to be installed for wall and ceiling conditions, special installation requirements, finishes, closing mechanisms, and hardware.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

PART 2 - PRODUCTS

2.1 LEED MATERIAL REQUIREMENTS, GENERAL

- A. This material must be compliant with the requirements of LEED-NC v4.1 EQc1: Low-Emitting Materials for the Wall Panels category. It may contain significant recycled content and must be properly documented for the requirements of LEED-NC v4.1 MRc4: Building Product Disclosure & Optimization: Sourcing of Raw Materials. Also provide documentation for MRc3: Building Product Disclosure & Optimization: Environmental Product Declarations (EPDs) Option 1, and MRc5: Building Product Disclosure & Optimization: Material Ingredients, Option 1 as they may be applicable.
- B. Requirements are summarized in specifications section 018113 of this document, and fully defined in the USGBC publication LEED v4.1 Building Design and Construction: Getting started guide for beta participants, published in July 2019 and all addenda to that document published on April 9, 2021 or thereafter.

2.2 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Babcock-Davis.
 - 2. J.L. Industries.
 - 3. Larsen's Manufacturing Company.

2.3 MATERIALS

- A. Sheet Steel: ASTM A36/A36M, commercial-quality, cold-rolled steel with baked-on, rust inhibitive primer.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Cold-Rolled Steel Sheets: ASTM A36/A36M, Commercial Steel (CS), or ASTM A620/A620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M. Electrolytic zinc-coated steel sheet, complying with ASTM A591/A591M, Class C coating, may be substituted at fabricator's option.
- D. Electrolytic Zinc-Coated Steel Sheet: ASTM A591/A591M, Commercial Steel (CS), with Class C coating and phosphate treatment to prepare surface for painting; with minimum thickness indicated representing specified nominal thickness according to ASTM A568/A568M for uncoated base metal.

2.4 INTERIOR ACCESS DOORS

- A. Furnish access doors of proper size for access to concealed equipment. Unless otherwise indicated, minimum size shall be 12-inch x 12-inch for hand access and minimum 18-inch x 18-inch for valve and actuator access and 24-inch x 24-inch for equipment access.
- B. Flush, Non-Rated Access Doors and Frames with Exposed Flanges: Fabricated from stainless-steel sheet.
 - 1. Locations: Wall and ceiling surfaces in Toilet Rooms, Custodial Rooms, and other Wet Areas.
 - 2. Frame: Minimum 0.060-inch- (1.5-mm-) thick sheet metal with 1-inch (25-mm wide, surface-mounted trim.
 - 3. Hinges: Continuous piano hinge.
 - 4. Hardware: Screwdriver-operated cam latch.
- C. GRG Units for Suspended Drywall Ceilings: ASTM C1335/C1335M and ASTM C1381
 - 1. Product: Chicago Metallic; GRG Access Doors, 8500 Series; or Armstrong Ceiling Solutions, Plasterform.
 - 2. Type: Lay-in panels; screwed to ceiling grid.
 - 3. Access Door: Rounded edges.
 - 4. Shell Thickness: 1/8" to 3/16".
 - 5. Fastener Test Pull Out (Metal Stud): 215 lb avg.
 - 6. Fastener Push-Through Test: 350 lb avg.
 - 7. Fuel Contribution: ASTM E84; 0.

8. Flame Spread: ASTM E84; 0.
9. Smoke Index: ASTM E84; 0.
10. Combustion: ASTM E84; Non-combustible.
11. Class A Non-Rated.

2.5 EXTERIOR ACCESS DOORS

- A. Exterior Flush Access Doors:
 1. Description: Weatherproof assembly, with face of door fit flush with frame and with exposed frame. Include extruded door gaskets and minimum 2-inch-thick (50-mmthick) fiberglass insulation.
 2. Locations: Wall.
 3. Door Size: 24"30".
 4. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage, factory primed for paint finish.
 5. Continuous hinge.
 6. Latch and Lock: Cam latch operated by handle, with preparation for mortise lock.

2.6 FABRICATION

- A. General: Provide access door assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
 1. Exposed Flanges: Nominal 1 inch (25 mm) wide around perimeter of frame.
 2. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction.
- D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 1. For keyed latches, furnish two keys per latch and key all latches alike.

2.7 STEEL FINISHES

- A. Surface Preparation: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface-preparation specifications and environmental exposure conditions of installed metal fabrications:
 1. Exteriors (SSPC Zone 1B): SSPC-SP6/NACE No. 3, "Commercial Blast Cleaning."
 2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
- B. Steel and Metallic-Coated-Steel Finishes:

1. Apply shop primer to uncoated surfaces of metal fabrications.
2. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.
- B. Furnish inserts and anchoring devices for access doors that must be built into other construction.
- C. Coordinate delivery with other work to avoid delay.

3.2 INSTALLATION

- A. Comply with manufacturer's instructions for installing access doors.
- B. Set frames accurately in position, mud edges, and securely attach to supports with face panels plumb and level in relation to adjacent finish.
- C. Coordinate location of access doors in hung ceilings, furred spaces and walls to provide access to concealed work items requiring maintenance and/or adjustment. Obtain approval of the CITY ENGINEER for the locations of such access doors.
- D. Locate and group equipment requiring access doors. Coordinate location of equipment with other trades to minimize number of access doors in one area.
- E. Frames, doors and trim pieces shall not vary from straightness or snug contact fit by more than 1/16-inch.
- F. Provide access doors for maintenance or adjustment purposes for mechanical system components, including but not limited to the following:
 1. Valves.
 2. Dampers.
 3. Concealed equipment.

3.3 ADJUSTING

- A. Adjust and clean hardware and panels after installation for proper operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

3.4 CLEANING

- A. Clean and prepare doors for painting in accordance with Section 099100.
- B. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

END OF SECTION 08 31 13

SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Door hardware required for swing doors, except special types of unique hardware specified in the same sections as the doors and door frames on which they are installed.

1.3 RELATED SECTIONS

- A. Section 081113 – Hollow Metal Doors and Frames: Silencers integral with hollow metal frames.
- B. Section 084113 – Aluminum-Framed Entrances and Storefronts: Aluminum entrance door hardware, including cylinders.
- C. Section 104400 – Fire Protection Specialties: Knox box.

1.4 PRODUCTS FURNISHED BUT NOT INSTALLED

- A. Cylinders for locks on entrance doors.

1.5 ACTION SUBMITTALS

- A. Product Data: Include manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements. Provide data for substituted items along with data for specified items to allow comparison for determination of acceptability of proposed substitution.
- B. Final Hardware Schedule: Coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
- C. Final Hardware Schedule Content: Based on hardware indicated, organize schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - 1. Type, style, function, size, and finish of each hardware item.
 - 2. Name and manufacturer of each item.
 - 3. Fastenings and other pertinent information.
 - 4. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - 5. Explanation of all abbreviations, symbols, and codes contained in schedule.

6. Mounting locations for hardware.
7. Door and frame sizes and materials.
8. Keying information.
- D. Submittal Sequence: Submit final schedule at earliest possible date particularly where acceptance of hardware schedule must precede fabrication of other work that is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by door hardware, and other information essential to the coordinated review of schedule.
- E. Templates: For doors, frames, and other work specified to be factory prepared for the installation of door hardware. Check shop drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

1.6 QUALITY ASSURANCE

- A. Supplier Qualifications: Door hardware supplier with warehousing facilities in Project's vicinity and who is or employs a qualified Architectural Hardware Consultant, available during the course of the Work to consult with Contractor and CITY ENGINEER about door hardware and keying.
- B. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.
- C. Regulatory Requirements: Comply with provisions of the following:
 1. Where indicated to comply with accessibility requirements, comply with CBC Chapter 11B as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
 - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
 - 2) Sliding or Folding Doors: 5 lbf (22.2 N) applied parallel to door at latch.
 - 3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch (13 mm) high. Bevel raised thresholds with a slope of not more than 1:2.
 2. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf (67 N) to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Delayed-Egress Locks: Lock releases within 15 seconds after applying a force not more than 15 lbf (67 N) for not more than 3 seconds.
 - c. Door Closers: Not more than 30 lbf (133 N) to set door in motion and not more than 15 lbf (67 N) to open door to minimum required width.
 - d. Thresholds: Not more than 1/2 inch (13 mm) high.
 3. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

- D. Fire-Rated Openings: Provide door hardware for fire-rated openings that complies with NFPA Standard No. 80 and requirements of authorities having jurisdiction. Provide only door hardware items listed that are identical to products tested by UL, Warnock Hersey, FM, or other testing and inspecting organization, acceptable to authorities having jurisdiction for use on types and sizes of doors indicated in compliance with requirements of fire- rated door and door frame labels.
- E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings." Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
 - 1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
 - 2. Preliminary key system schematic diagram.
 - 3. Requirements for key control system.
 - 4. Address for delivery of keys.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings." Review methods and procedures related to electrified door hardware including, but not limited to, the following:
 - 1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
 - 2. Review sequence of operation for each type of electrified door hardware.
 - 3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
 - 4. Review required testing, inspecting, and certifying procedures.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging of door hardware is responsibility of supplier. As hardware supplier receives material from various manufacturers, sort and repackage in containers clearly marked with appropriate hardware set number to match set numbers of approved hardware schedule. Two or more identical sets may be packed in same container.
- B. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).
- C. Provide secure lock-up for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable so that completion of the Work will not be delayed by hardware losses both before and after installation.

1.8 MAINTENANCE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for CITY's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 LEED MATERIAL REQUIREMENTS, GENERAL

- A. This material shall contain significant recycled content and must be properly documented

for the requirements of LEED-NC v4.1 MRc4: Building Product Disclosure & Optimization: Sourcing of Raw Materials. Also provide documentation for MRc3: Building Product Disclosure & Optimization: Environmental Product Declarations (EPDs) Option 1 and MRc5: Building Product Disclosure & Optimization: Material Ingredients, Option 1, as applicable.

- B. Credit requirements are summarized in specifications section 018113 of this document, and fully defined in the USGBC publication LEED v4.1 Building Design and Construction: Getting started guide for beta participants, published in July 2019 and all addenda to that document published on April 9, 2021 or thereafter.

2.2 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following. Substitutions under provisions of Section 012513. Item Manufacturer Acceptable Substitutes
- B. Hinges Hager Ives, McKinney
- C. Locks, Latches & Cylinders Schlage Yale
- D. Exit Devices Von Duprin None
- E. Overhead Closers LCN DORMA, Norton
- F. Push, Pulls & Protection Plates Ives Trimco, BBW
- G. Flush Bolts, Coordinators Ives DCI, Glynn-Johnson
- H. Dust Proof Strikes Ives BBW/Trimco
- I. Coordinators Ives Glynn-Johnson, BBW/Trimco
- J. Stops Ives BBW/Trimco
- K. Overhead Stops Glynn-Johnson None
- L. Thresholds Pemko National Guard, Zero
- M. Seals and Bottoms Pemko Hager, Zero
- N. Electromagnetic Holders Rixson-Firemark Glynn-Johnson, Sargent
- O. Astragals Pemko Hager

2.3 LOCKSET AND LATCHSET STYLES AND FINISHES

- A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)." and State of California Title 24.
 - 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 (22 N).
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf (67 N) to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Mortise Type: Schlage, L Series, 17 lever design with 'B' rose, or approved equal, function as scheduled.
 - 1. Finish: 626 finish.
 - 2. Backset: 2-3/4-inches, unless otherwise scheduled.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled

fire doors, and as follows:

1. Bored Locks: Minimum 1/2-inch (13-mm) latchbolt throw.
 2. Mortise Locks: Minimum 3/4-inch (19-mm) latchbolt throw.
 3. Deadbolts: Minimum 1-inch (25-mm) bolt throw.
- E. Rabbeted Meeting Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.
- F. Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

2.4 NUMBER OF HINGES

- A. Provide number of hinges indicated but not less than 3 hinges per door leaf and as follows:
1. For doors 90 inches or less in height: 3 hinges; one additional hinge for each 30 inches of additional height.
 2. For doors up to 36 inches wide: 3 hinges.
 3. For doors over 36 inches wide: 4 hinges.
 4. Hinge Type: Ball bearing type throughout, unless noted otherwise.
- B. Hinge Weight: Unless otherwise indicated, provide the following:
1. Entrance Doors: Heavy-weight hinges.
 2. Doors with Closers: Antifriction-bearing hinges.
 3. Interior Doors: Standard-weight hinges.
- C. Hinge Base Metal: Unless otherwise indicated, provide the following:
1. Exterior Hinges: Stainless steel, with stainless-steel pin.
 2. Interior Hinges: Stainless steel, with stainless-steel pin.
 3. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.
- D. Provide hinges with non-removable pins (NRP) at exterior doors and out-swinging interior doors.
- E. Provide butts of proper width to clear trim projection when the door swings 180 degrees. Where partition layout permits, doors shall swing 180 degrees.

2.5 LOCK CYLINDERS AND KEYING

- A. Review the keying system with the CITY ENGINEER and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with CITY's existing system.
- B. Equip locks with manufacturer's standard 6-pin tumbler cylinders.
- C. Equip locks with high-security cylinders that comply with performance requirements for Grade 1 cylinders as listed in ANSI/BHMAA156.5 and that have been tested for pick and drill resistance requirements of UL 437 and are UL listed.
- D. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.
- E. Comply with CITY ENGINEER's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock that is not designated to be keyed alike with a group of related locks.
- F. Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation, "DO NOT DUPLICATE."
- G. Key Material: Provide keys of nickel silver only.

- H. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.
- I. Deliver keys to CITY ENGINEER.

2.6 LOCKS, LATCHES, AND BOLTS

- A. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
 - 1. Strikes for Bored Locks and Latches: BHMA A156.2.
 - 2. Strikes for Mortise Locks and Latches: BHMA A156.13.
 - 3. Strikes for Interconnected Locks and Latches: BHMA A156.12.
 - 4. Strikes for Auxiliary Deadlocks: BHMA A156.5.
- B. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.
- C. Lock Throw: Provide 5/8-inch minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
- D. Provide 1/2-inch minimum throw of latch for other bored and pre-assembled types of locks and 3/4-inch minimum throw of latch for mortise locks. Provide 1-inch minimum throw for all dead bolts.
- E. Flush Bolt Heads: Minimum of 1/2-inch-diameter rods of brass, bronze, or stainless steel with minimum 12-inch-long rod for doors up to 7'-0" in height. Provide longer rods as necessary for doors exceeding 7'-0" in height.

2.7 CLOSERS AND DOOR CONTROL DEVICES

- A. Size of Units: Except as otherwise specifically indicated, comply with the manufacturer's recommendations for size of door control unit depending on size of door, exposure to weather, and anticipated frequency of use.
 - 1. Provide non-sized units to provide a full range (1 to 4) closing power for all sizes according to BHMA product standards (ANSI 156.4-1986, Table I) and listed in BHMA Certified Products Directory to provide minimum closing force required to properly latch the doors as tested by an independent testing lab. For barrier-free applications, furnish adjustable closer spring power, to provide less than 5 lbs opening force for doors 36- to 48-inches wide.
 - 2. Set opening force at 5 pounds for exterior and interior doors.
 - 3. When fire doors are required, the maximum effort to operate the door may be increased to the minimum allowable by the appropriate Administrative Authority, not to exceed 15 lbs, per 1133B.2.5.
 - 4. Adjust sweep period of closers so that from an open position of 70-degrees, the door will take at least 3-seconds to move to appoint 3-inches from the latch, measured to the landing edge of the door per CBC 1133B.2.5.1.
- B. Provide integral smoke detector device in combination door closers and holders complying with UL 228.

2.8 EXIT DEVICES

- A. General: No vertical rod or concealed rod devices will be accepted; only rim devices with keyed mullions are acceptable.
- B. All moving parts shall be easily removable for repair and maintenance; moving parts that are riveted or swaged in place are not acceptable.
- C. Provide dead latching latch bolts with wide stile devices to ensure safe and secure opening.
- D. Supply outside trims of wrought construction.
- E. Retain a factory service technician at the completion of installation to ensure proper adjustment and operation of devices. Obtain a written report upon completion of service inspection.
- F. The entire length of the push bar shall act as one piece.
- G. Finish: Stainless steel, plated or finished as specified; aluminum or brass are not acceptable.
- 1. Not Acceptable: Moving parts made of die-cast "pot" or "white" metals.
- H. Panic hardware shall comply with 1997 CBC Standard 10-4.

2.9 PUSH PLATES, PULL PLATES, AND ARMOR PLATES

- A. Minimum Thickness: 1/16-inch; bevel 4 sides.
- B. Pull Plates: Supply without screw holes when used with pulls. Bolt pulls through the door at the grip only.
- C. Armor and Kick Plates: Countersunk installation.
- D. Finish: Stainless steel.

2.10 SURFACE AND FLUSH BOLTS

- A. Provide lever arm with the following characteristics:
 - 1. Arm not friction-operated.
 - 2. Arm that is connected to the bolt mechanism.
- B. Shape face plates to match the door edge.
- C. Provide dustproof strikes where bolts engage the floor, threshold or curb.
- D. Operating Mechanism Locations: Bottom bolt not more than 12-inches from the floor; top bolt not more than 72-inches from the floor.
- E. Surface Bolts: Provide with a dustproof strike or an easy-to-clean floor strike.
- F. Lifting Handles of Surface Bolts: Mechanically fastened (not press fitted).

2.11 STOPS AND HOLDERS

- A. General: Provide stops and holders fabricated from solid or forged bronze; wrought is not acceptable.
- B. Do not locate stops in the path of travel (POT). Locate a maximum of 4-inches from walls in accordance with DSA Policy 99-08.
- C. Wall-mounted Stops: Provide with concealed fasteners.
- D. Rubber Bumpers: Fastened by a pin or screw that goes through the rubber and seats into the metal on the opposite side. A rubber bumper that is screwed into the metal holder is acceptable.

2.12 WEATHERSTRIPPING AND SEALS

- A. General: Provide continuous weatherstripping on exterior doors and smoke, light, or sound seals on interior doors where indicated or scheduled. Provide non-corrosive fasteners for exterior applications and elsewhere as indicated.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strip is easily replaceable and readily available from stocks maintained by manufacturer.
- C. Weatherstripping at Jambs and Heads: Extruded aluminum with natural anodized finish, 0.062-inch minimum thickness of main walls and flanges and flexible vinyl hollow bulb or loop insert.
- D. Weatherstripping at Door Bottoms: Extruded aluminum with natural anodized finish, 0.062-inch minimum thickness of main walls and flanges.

2.13 THRESHOLDS

- A. General: Except as otherwise indicated, provide standard, single length, metal threshold unit of type, size, and profile as shown or scheduled.
 - 1. Comply with requirements of CBC Section 1133B.2.4.1.
 - 2. Provide with a reinforcing center leg.
 - 3. Field-cut ends to fit jamb profile.
 - 4. Provide standard metal thresholds of type, size and profile indicated or scheduled. Fabricate to accommodate door hardware.
- B. Exterior Hinged or Pivoted Doors: Provide units not less than 4-inches wide, formed to accommodate change in floor elevation where indicated, fabricated to accommodate door hardware and to fit door frames, and as follows:
 - 1. For in-swinging doors provide units with interlocking lip and interior drain channel; include hook on bottom edge of door and drain pan.
 - 2. For out-swinging doors provide units with interlocking lip and with hook on bottom edge of door to act as weather bar.

2.14 HARDWARE FINISHES

- A. Match items to the manufacturer's standard color and texture finish for the latch and lock sets (or push-pull units if no latch or lock sets).
- B. Provide finishes that match those established by BHMA.
- C. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- D. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated.
- E. The designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in following applicable publications, except as

specifically indicated or required to comply with governing regulations and except as otherwise directed by CITY ENGINEER.

1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.
 2. NWWDA Industry Standard I.S.1.7, "Hardware Locations for Wood Flush Doors."
- B. Hardware Locations:
1. Hinges:
 - a. Bottom Hinge: 10-inches from door bottom to bottom of hinge.
 - b. Top Hinge: 5-inches from door top to top of hinge.
 - c. Center Hinge: center between top and bottom hinge.
 - d. Intermediate Hinges: Equally spaced between top and bottom hinge, or equally spaced where there is more than one intermediate hinge.
 2. Locksets and Latchsets: 38-inches from bottom of door to center of lever.
 3. Push Bars: 48-inches from bottom of door to center of plate.
 4. Pull Plates: 42-inches from bottom of door to center of plate.
 5. Exit Devices: 38-inches from bottom of door to center of pad.
 6. Deadlock Strike: 48-inches from floor, centered.
- C. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Where cutting and fitting is required to install hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation or application of surface protection with finishing work. Do not install surface-mounted items until finishes have been completed on the substrates involved.
- D. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- F. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant.
- G. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING

- A. Adjust and check each operating item of hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate freely and smoothly or as intended for the application made.
- B. Where door hardware is installed more than one month prior to acceptance or occupancy of a space or area, return to the installation during the week prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors.
- C. Instruct CITY's personnel in the proper adjustment and maintenance of door hardware and hardware finishes.

3.3 CLEANING

- A. Clean adjacent surfaces soiled by hardware installation.
- B. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

END OF SECTION 087100

SECTION 08 91 00 - WALL LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Fixed metal louvers and frames at exterior locations.
- B. Blank off panels.

1.3 RELATED SECTIONS

- A. Section 092216 - Non-Structural Metal Framing.
- B. Section 092400 Portland Cement Plaster, 3-Coat Stucco.
- C. Division 23 – HVAC Fans.

1.4 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 axes of the blades are horizontal).
- C. 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.

1.5 ACTION SUBMITTALS

- A. Product Data: Provide data describing design characteristics, maximum recommended air velocity, design free area, materials and finishes.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: Indicate louver layout plan and elevations, opening and clearance dimensions, tolerances; head, jamb and sill details; blade configuration, screens, blank off areas required, and frames.

1.6 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Warranty: Executed special warranty specified in this Section.

1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code--Steel."
 - 2. AWS D1.2, "Structural Welding Code--Aluminum."
 - 3. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 4. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver metal louvers so as not to be damaged or deformed. Package louvers for protection during transportation and handling.
- B. Store louvers vertically, covered with suitable weathertight and ventilated covering. Store louvers to ensure dryness, with positive slope for drainage of water. Do not store louvers in contact with other materials that might cause staining, denting, or other surface damage.
- C. Protect strippable protective covering on louvers from exposure to sunlight and high humidity, except to extent necessary for period of louver installation.

1.10 SITE CONDITIONS

- A. Field Measurements: Verify louver openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1.11 WARRANTY

- A. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials, fabrication or installation within specified warranty period. Warranty does not include normal weathering.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of metals, metal finishes, and other materials beyond normal weathering in a marine environment.
 - 2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Louvers shall 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 shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.
- B. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. Design earthquake spectral response acceleration, short period (Sds) for Project is indicated on Structural Drawings.
 - 2. Component Importance Factor: 1.5.
- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. The Airolite Company, LLC.
 - 2. Construction Specialties, Inc.

2.3 MATERIALS

- A. Galvanized-Steel Sheet: ASTM A653/A653M, G90 (Z275) zinc coating, mill phosphatized.
- B. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
 - 1. Use types and sizes to suit unit installation conditions.
 - 2. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.
 - 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainlesssteel fasteners.
 - 4. For color-finished louvers, use fasteners with heads that match color of louvers.
- C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E488/E488M, conducted by a qualified independent testing agency.
- D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.
- E. Flashings: Of same material as louver frame.
- F. Sealants: As recommended by louver manufacturer.

2.4 FIXED, FORMED-METAL LOUVERS

- A. Horizontal, Drainable-Blade Louver: Factory welded assembly complete with steel stormresistant blades, bird screen, steel sills, integral structural supports and blade braces.
 - 1. Blade Profile: Single, drainable.
 - 2. Frame and Blade Nominal Thickness: As required to comply with structural performance requirements, but not less than 0.052 inch (1.32 mm) for frames and 0.040 inch (1.02 mm) for blades.
 - 3. Material: Galvanized steel.
 - 4. Finish: Baked-enamel or powder-coat as standard with manufacturer, color to be selected.
 - 5. Free Area Requirements: 50 percent net free area.
 - 6. Louver Depth: TBD.
 - 7. Mullion Type: As indicated on Drawings.
 - 8. Basis-of-Design Product: Model 658; as manufactured by Industrial Louvers, Inc.
 - 9. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- B. Blank-off Panels: Manufacturer's standard insulated panels of same material and finish as louver.
 - 1. R-value of Blank-off Panels: Match R-value of adjacent wall construction.
- C. Gasketing: PVC compression gaskets, 1/2- by 1/2-inch, or 1/4-inch bead of silicone sealant.

2.5 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening.
- B. Secure screens to louver frames with stainless-steel machine screws, spaced a maximum of 6-inches (150 mm) from each corner and at 12-inches (300 mm) oc.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached.
 - 2. Finish: Mill finish, unless otherwise indicated.
 - 3. Type: Non-rewirable, U-shaped frames for permanently securing screen mesh.
- D. Louver Screening for Galvanized-Steel Louvers:
 - 1. Bird Screening: Galvanized steel, 1/2-inch- (13-mm-) square mesh, 0.041-inch (1.04-mm) wire.

2.6 FABRICATION

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- C. 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. Louver Frame: Channel shape, welded corner joints.
2. Louver Panel Thickness: 6-inches deep.
- D. Include supports, anchorages, and accessories required for complete assembly.
- E. Where indicated, provide subsills made of same material as louvers or extended sills for recessed louvers.
- F. Join frame members to each other and to fixed louver blades with fillet welds concealed from view, unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.
- G. Head and Sill Flashings: Roll formed or extruded to required shape, single length in one piece per location.

2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

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 suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A780/A780M.
- C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil (0.025 mm) for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils (0.05 mm).
 1. Color and Gloss: Match adjacent finish color.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that prepared openings and flashings are ready to receive work and opening dimensions are as indicated on Shop Drawings.

3.2 INSTALLATION

- A. Install louver assembly in accordance with manufacturer's instructions.
 1. Strip protective finish coverings prior to installing fasteners and where installation will be tight to adjacent construction.
- B. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- C. 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.

- D. Form closely fitted joints with exposed connections accurately located and secured.
- E. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- F. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.
- H. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 079200 for sealants applied during louver installation.
- I. Install flashings and align louver assembly to ensure moisture shed from flashings and diversion of moisture to exterior.
- J. Secure louvers in opening framing with concealed fasteners.
- K. For mechanical intake and exhaust louvers, provide insulated blank-off panels for all unused sections of louver.

3.3 ADJUSTING

- A. Strip protective finish coverings.
- B. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by CITY ENGINEER, 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.

3.4 CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate until final cleaning.
- 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. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

END OF SECTION 089100

DIVISION 09

Finishes

SECTION 096723 – RESINOUS FLOORING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Resinous flooring systems with epoxy body coat(s) at Restrooms over Dragon Board and over lightweight concrete.
 - 1. Application Method: Troweled or screeded.

1.3 LEED REQUIREMENTS

- A. This project is required to be Leadership in Energy and Environmental Design (LEED®) NC v4 certified at Gold level. Certain designated credits will be pursued per the requirements of LEED-NC v4.1 and addenda current as of April 2021. See Section 018113 "Sustainable Design Requirements" for related product and procedure requirements, references, definitions, documentation requirements, action plans, meetings, and performance requirements of products and systems which relate to the scope of all designers, contractors, and suppliers.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include manufacturer's technical data, application instructions, and recommendations for each resinous flooring component required.
- B. Samples for Verification: For each resinous flooring system required, 6 inches (150 mm) square, applied to a rigid backing by Installer for this Project.

1.5 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by manufacturer certifying that installers comply with specified requirements.
- B. Material Certificates: For each resinous flooring component, signed by manufacturer.

1.6 CLOSEOUT SUBMITTALS

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

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who is experienced in applying resinous flooring systems similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance, and who is acceptable to resinous flooring manufacturer.

1. Engage an installer who is certified in writing by resinous flooring manufacturer as qualified to apply resinous flooring systems indicated.
- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, grouting coats, and topcoats, through one source from a single manufacturer. Provide secondary materials, including patching and fill material, joint sealant, and repair materials, of type and from source recommended by manufacturer of primary materials.
- C. Mockups: Apply mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 1. Apply full-thickness mockups on 48-inch- (1200-mm-) square floor area selected by Architect.
 - a. Include 48-inch (1200-mm) length of integral cove base.
 2. Simulate finished lighting conditions for Architect's review of mockups.
 3. 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 packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.
- C. Store material(s) in accordance with manufacturer's instructions, with seals and labels intact and legible. Maintain temperatures within the required range. Do not use materials which exceed the manufacturer's maximum recommended shelf life.
- D. Provide equipment and personnel to handle the materials by methods which prevent damage.
- E. Promptly inspect direct jobsite material deliveries to assure that quantities are correct, comply with requirements and are not damaged.

1.9 SITE CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring application.
- B. The minimum slab temperature must be conditioned to 60 degrees F before commencing installation, during installation, and for at least 72 hours after installation is complete. The substrate temperature must be at least 5 degrees F above the dew point during installation.
- C. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring application.
- D. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

PART 2 - PRODUCTS

2.1 LEED MATERIAL REQUIREMENTS, GENERAL

- A. This material must be compliant with the requirements of LEED-NC v4.1 EQc1: Low-Emitting Materials for the Paints and Coatings category. Also provide documentation for MRc3: Building Product Disclosure & Optimization: Environmental Product Declarations (EPDs) Option 1, and MRc5: Building Product Disclosure & Optimization: Material Ingredients, Option 1 as they may be applicable.
- B. Requirements are summarized in specifications section 018113 of this document, and fully defined in the USGBC publication LEED v4.1 Building Design and Construction: Getting started guide for beta participants, published in July 2019 and all addenda to that document published on April 9, 2021 or thereafter.

2.2 RESINOUS FLOORING

- A. Basis-of-Design Product: The design for the resinous flooring system is based on the manufacturer identified below. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:
 - 1. Basis-of-Design: Stonhard; Stonproof ME7 waterproofing membrane at 3mm total finish thickness is comprised of a two-component polyurethane elastomeric membrane, a three-component epoxy undercoat with brightly colored, flake broadcast, and a two-component, UV light resistant, high performance, clear epoxy sealer and a non-reflective water-based, aliphatic polyurethane finish coat.
 - 2. ChemMasters.
 - 3. Pacific Polymers, Inc.
- B. System Characteristics:
 - 1. Color and Pattern: Blue Ridge, Large Flake.
 - 2. Wearing Surface: Manufacturer's standard orange-peel texture.
 - 3. Integral Cove Base: 6 inches (100 mm) high.
 - 4. Overall System Thickness: 3/16 inch (4.8 mm).
- C. System Components: Manufacturer's standard components that are compatible with each other and as follows:
 - 1. Waterproofing Membrane:
 - a. Resin: Polyurethane
 - b. Formulation Description: Two-component, liquid applied, polyurethane elastomer, with 200% elongation per ASTM D412.
 - c. Type: Pigmented
 - d. Application Method: 30mil notched rubber squeegee, back-rolled with a spiked roller and broadcast with Texture #3.
 - e. Application Thickness: 60 mil minimum
 - f. Number of Coats: 1
 - 2. Under Coat (Stonshield Undercoat):
 - a. Resin: Epoxy
 - b. Formulation Description: Three-component, free flowing epoxy formulation consisting of resin, curing agent and fine aggregate.
 - c. Type: Clear
 - d. Application Method: Squeegee and medium nap roller
 - e. Application Thickness: 25 mil minimum
 - f. Finish: Gloss
 - g. Number of Coats: 1
 - 3. Broadcast Flake (Stontec Decorative Flake):

- a. Resin: N/A
- b. Formulation Description: Brightly colored flake
- c. Type: Multi-Color
- d. Application Method: Hand
- e. Finish: N/A
- f. Number of Coats: 1
- 4. Coat/ Finish Sealer (Stonkote CE4):
 - a. Resin: Epoxy
 - b. Formulation Description: Two-component, high performance, UV resistant, epoxy.
 - c. Type: Clear
 - d. Finish: Gloss
 - e. Number of Coats: 2

2.3 ACCESSORIES

- A. Expansion/Isolation Joint Sealant Materials:
 - 1. Stonflex MP7: Two-component, pourable polyurethane sealant.
- B. Coved Base:
 - 1. Stonclad GS Cove with Stontec ERF: Three-component, epoxy cove base mortar applied to the height indicated on Drawings and Finish Schedule.
 - 2. Cove Strip: "L" shaped extruded metal; dimensions 1/8" x 1/2".
- C. Patching and Fill Material: Resinous product of or approved by resinous flooring manufacturer and recommended by manufacturer for application indicated.
- D. Joint Sealant: Type recommended or produced by resinous flooring manufacturer for type of service and joint condition indicated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. General: Prepare and clean substrates according to resinous flooring manufacturer's written instructions for substrate indicated. Provide clean, dry, and neutral Ph substrate for resinous flooring application.
- B. Concrete Substrates: Provide sound concrete surfaces free of laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants incompatible with resinous flooring.
 - 1. Roughen concrete substrates as follows:
 - a. Comply with ASTM C811 requirements, unless manufacturer's written instructions are more stringent.
 - 2. Repair damaged and deteriorated concrete according to resinous flooring manufacturer's written recommendations.
 - 3. Verify that concrete substrates are dry.
 - a. Perform anhydrous calcium chloride test, ASTM F1869. Proceed with application only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) of slab in 24 hours.
 - b. Perform plastic sheet test, ASTM D4263. Proceed with application only after testing indicates absence of moisture in substrates.
 - c. Perform additional moisture tests recommended by manufacturer. Proceed with application only after substrates pass testing.

4. Verify that concrete substrates have neutral Ph and that resinous flooring will adhere to them. Perform tests recommended by manufacturer. Proceed with application only after substrates pass testing.
- C. Resinous Materials: Mix components and prepare materials according to resinous flooring manufacturer's written instructions.
- D. Use patching and fill material to fill holes and depressions in substrates according to manufacturer's written instructions.
- E. Treat control joints and other nonmoving substrate cracks to prevent cracks from reflecting through resinous flooring according to manufacturer's written recommendations.

3.2 APPLICATION

- A. General: Apply components of resinous flooring system according to manufacturer's written instructions to produce a uniform, monolithic wearing surface of thickness indicated.
 1. Coordinate application of components to provide optimum adhesion of resinous flooring system to substrate, and optimum intercoat adhesion.
 2. Cure resinous flooring components according to manufacturer's written instructions. Prevent contamination during application and curing processes.
 3. At substrate expansion and isolation joints, provide joint in resinous flooring to comply with resinous flooring manufacturer's written recommendations.
 - a. Apply joint sealant to comply with manufacturer's written recommendations.
- B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.
- C. Resinous Flooring:
 1. Primer: Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates
 2. 2. Under Coat: Remove any surface irregularities by lightly abrading and vacuuming the floor surface. Mix and apply undercoat with strict adherence to manufacturer's installation procedures and coverage rates.
 3. 3. Broadcast: Immediately broadcast flake into the undercoat using manufacturer's specially designed spraycaster. Strict adherence to manufacturer's installation procedures and coverage rates is imperative.
 4. 4. Sealer/Grout Coat: Remove excess unbonded flakes by lightly sanding and vacuuming the floor surface. Mix and apply sealer with strict adherence to manufacturer's installation procedures.
 5. 5. Finish Sealer: After sealer/grout coat has cured, lightly sand surface. Vacuum and apply finish sealer with strict adherence to manufacturer's installation procedures and coverage rates.
- D. Integral Cove Base: Apply cove base mix to wall surfaces before applying flooring. Apply according to manufacturer's written instructions and details including those for taping, mixing, priming, troweling, sanding, and topcoating of cove base. Round internal and external corners.
- E. Apply troweled or screeded body coat(s) in thickness indicated for flooring system. Hand or power trowel and grout to fill voids. When cured, sand to remove trowel marks and roughness.
- F. Apply grout coat, of type recommended by resinous flooring manufacturer to fill voids in surface of final body coat and to produce wearing surface indicated.

- G. Apply topcoat(s) in number of coats indicated for flooring system and at spreading rates recommended in writing by manufacturer.
- H. Sealant: Mix and apply sealant to properly prepared cut joints (if any). The use of a polyethylene backer rod should be used in expansion and/or isolation joints.
- I. Cure resinous flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process.
 - 1. Close area of application for a minimum of 24 hours.

3.3 FIELD QUALITY CONTROL

- A. Core Sampling: At the direction of CITY ENGINEER and at locations designated by CITY ENGINEER, take 1 core sample per 1000 sq. ft. (92.9 sq. m) of resinous flooring, or portion of, to verify thickness. For each sample that fails to comply with requirements, take two additional samples. Repair damage caused by coring and correct deficiencies.
- B. Material Sampling: CITY ENGINEER may at any time and any number of times during resinous flooring application require material samples for testing for compliance with requirements.
 - 1. CITY ENGINEER will engage an independent testing agency to take samples of materials being used. Material samples will be taken, identified, sealed, and certified in presence of Contractor.
 - 2. Testing agency will test samples for compliance with requirements, using applicable referenced testing procedures or, if not referenced, using testing procedures listed in manufacturer's product data.
 - 3. If test results show applied materials do not comply with specified requirements, pay for testing, remove noncomplying materials, prepare surfaces coated with unacceptable materials, and reapply flooring materials to comply with requirements.

3.4 PROTECTION OF ADJACENT WORK

- A. General: Resinous floor system will be installed in locations where other adjacent finish materials, including ornamental metal, lath and plaster, and other finish assemblies may already be in place. Protect all adjacent surfaces during installation and finishing.
 - 1. Installed adjacent finishes shall be completely isolated from epoxy coating system installation.
 - 2. Provide constant supervision and immediate clean up throughout resinous floor system installation.
 - 3. After resinous floor system has fully cured, remove protection from adjacent surfaces and wipe down surfaces using clean, cotton towels.

3.5 ADJUSTING

- A. Remove temporary covering just prior to final inspection.

3.6 CLEANING

- A. Clean the resinous flooring system just prior to final inspection, using materials and procedures recommended by the system manufacturer.
- B. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

3.7 PROTECTING

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

END OF SECTION 096723

SECTION 09 91 00 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Surface preparation, painting, and finishing of exposed interior and exterior items and surfaces.
- B. Surface preparation, priming, and finish coats specified in this Section are in addition to shoppriming and surface treatment specified under other Sections.
- C. Painting exposed surfaces whether or not colors are designated in schedules, except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the CITY ENGINEER will select from standard colors or finishes available.
- D. Painting includes field-painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.
- E. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
- F. Labels: Do not paint over Underwriters Laboratories, Factory Mutual or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 RELATED SECTIONS

- A. Section 055000 – Metal Fabrications: Shop-priming ferrous metal.
- B. Section 055213 - Pipe and Tube Railings: Shop-priming ferrous metal.
- C. Section 064100 – Architectural Woodwork: Shop finishing.
- D. Section 072400 – Direct-Applied Finish System (DAFS).
- E. Section 081113 – Hollow Metal Doors and Frames: Shop-priming ferrous metal.
- F. Section 083113 – Access Doors: Shop-primed doors for field painting.
- G. Section 092400 – Portland Cement Plaster.
- H. Section 092900 – Gypsum Board.

1.4 ACTION SUBMITTALS

- A. Product Data: For each paint system specified.
 - 1. Material List: Provide an inclusive list of required coating materials. Indicate

- each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and coating material proposed for use.
- 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use.
- 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate.
 - 1. Provide list of material and application for each coat of each finish sample.
 - 2. Brush-Outs: Submit 3 samples of each color and material on hardboard, 8-1/2" x 11" minimum.
 - 3. Step coats on Samples to show each coat required for each system.
 - 4. Label each coat of each Sample.
 - 5. Label each Sample to identify location and application area.
 - 6. Opaque Colors and Finishes: Submit samples using materials accepted for Project, of each color and paint finish selected with texture to simulate actual conditions.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For paint to include in maintenance manuals. Include the following:
 - 1. Methods for maintaining paint, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
 - 2. Precautions for cleaning materials and methods that could be detrimental to each type of paint specified.
- B. Provide paint cards fully labeled with manufacturer of each paint system applied on the project. Provide the following with each system:
 - 1. Manufacturer name.
 - 2. Manufacturer's paint product.
 - 3. Primer name and number.
 - 4. Color name and number.
 - 5. Gloss level.
 - 6. Locations where used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
 - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

1.7 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by the same

manufacturer as the finish coats.

- B. Field Samples: Apply field sample 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 prior to commencing work.
1. CITY ENGINEER will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: CITY ENGINEER will designate items or areas required.
 2. Components: One full component as directed.
 3. Simulate finished lighting conditions for review.
 4. Install field sample using means and methods identical to those that are going to be employed during full production.
 5. Allow coating to cure in accordance with manufacturer's written instructions.
 6. Perform adhesion test on existing paint to remain using X-cut method per ASTM D3359. Ratings 4A and 5A acceptable.
 7. Final approval of color selections will be based on field sample.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by CITY ENGINEER at no added cost to CITY.
 8. Approval of field sample does not constitute approval of deviations from the Contract Documents contained in field sample unless CITY ENGINEER specifically approves such deviations in writing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F (7 deg C). Maintain containers used in storage in a clean condition, free of foreign materials and residue.
- C. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.9 SITE CONDITIONS

- A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 deg F (10 deg C) and 90 deg F (32 deg C).

- B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 deg F (7 deg C) and 95 deg F (35 deg C).
- C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- D. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by the manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering interior 0-low VOC paint products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore; EcoSpec WB.
 - 2. Dunn-Edwards; SPARATAZERO Zero VOC.
 - 3. Glidden Professional; Lifemaster No VOC.
 - 4. Kelly-Moore; Enviro-Cote.
 - 5. PPG Architectural Finishes; Pure Performance.
 - 6. Sherwin-Williams; Promar Coating System.
- B. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering exterior paint products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Benjamin Moore.
 - 2. Dunn-Edwards.
 - 3. Glidden Professional.
 - 4. Kelly-Moore.
 - 5. PPG Architectural Finishes.
 - 6. Sherwin-Williams.

2.2 PAINT MATERIALS

- A. Material Compatibility: Provide block fillers, primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- B. Material Quality: Provide the manufacturer's best-quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.
- C. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish the manufacturer's material data and certificates of performance for proposed substitutions.
- D. Colors: Match colors indicated by reference to the manufacturer's standard color designations.

- E. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
1. Flat Paints and Coatings: 50 g/L.
 2. Non-Flat Paints and Coatings: 100 g/L.
 3. Non-Flat, High-Gloss Paints and Coatings: 150 g/L.
 4. Dry-Fog Coatings: 150 g/L.
 5. Primers, Sealers, and Undercoaters: 100 g/L.
 6. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 7. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 8. Pretreatment Wash Primers: 420 g/L.
 9. Floor Coatings: 100 g/L.
 10. Shellacs, Clear: 730 g/L.
 11. Shellacs, Pigmented: 550 g/L.

2.3 LIFE OF FILM

- A. The color of surfaces finished under this Section shall, at the end of one year, remain free from serious fading and the variation, if any, shall be uniform. The original adherence of materials shall be maintained for one (1) year and during this period there shall be no evidence of any blisters, running, peeling, scaling, chalking, streaks or stains. Washing with alkali-free soap and water shall remove surface dirt without producing the above or other deteriorating effects.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions under which painting will be performed for compliance with paint application requirements. Surfaces receiving paint must be thoroughly dry before paint is applied.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- C. Notify the CITY ENGINEER about anticipated problems using the materials specified over substrates primed by others.
- D. 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. Wood: 15 percent.
 4. Gypsum Board: 12 percent.
 5. Portland Cement Plaster: 12 percent.
- E. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
1. Beginning coating application constitutes acceptance of substrates and conditions.

3.2 PREPARATION, GENERAL

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted, or provide surfaceapplied protection prior to surface preparation and painting. Remove these items, if necessary, to completely paint the items and adjacent surfaces.
 - 1. Remove all staples, push pins, nails, and miscellaneous fasteners, hardware, abandoned wires, paper, and junk, etc. from all surfaces to receive paint. Patch or fill all holes and prep for finishing.
- B. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease prior to cleaning. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Provide barrier coats over incompatible primers or remove and reprime. Notify CITY ENGINEER in writing about anticipated problems using the specified finish-coat material with substrates primed by others.
- D. Follow proper procedures, methods, guidelines, and regulations for paint preparation related to lead paint sanding. Wear goggles, NIOSH-approved respirators, rubber gloves, and appropriate clothing.
- E. Clean building exterior using pressurized hot water.
 - 1. Clean heavily soiled areas with fiber brush and water.
 - 2. Equip pressure washer with fan tip nozzle of 250 degree minimum.
 - 3. Do not permit water temperature to exceed 180 degrees F.
 - 4. Do not permit water pressure to exceed 1,200 psi.
- F. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.
- G. Exposed Equipment: Verify installations are complete before initiating preparation of surfaces of exposed mechanical and electrical piping, conduit, ductwork, and equipment for field-painting.
- H. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by the paint manufacturer, and touch up with the same primer as the shop coat.
- I. Factory-Primed and Enamel Substrates: Wipe clean and dry.
- J. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

3.3 SURFACE PREPARATION

- A. Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
 - 1. Remove all hardware and other obstacles prior to painting and protect so that factory finish is not damaged in any manner. This shall include, but not be limited to, light fixtures, plates, grilles, name plates, and other similar items.
 - 2. Removal, disconnection, reconnection, and reinstallation shall be performed by skilled workers in the trades involved.

3. Items that cannot be removed and are to remain paint-free shall be protected by masking or other appropriate means to ensure a neat and clean paint job.
- B. Removable Equipment: Remove and reinstall heating equipment including thermostats, fan speed switches, and other associated controls, built-in furniture, plumbing fixtures such as toilets, stand-alone sink cabinets, and other equipment and furniture that can be removed, painted behind, and reinstalled.
 1. Removal, disconnection, reconnection, and reinstallation shall be performed by skilled workers in the trades involved.
 2. Equipment that is to remain in place will be identified by the District Representative.
 3. It is the Contractor's responsibility to verify such equipment and furniture and include all items in their bid price.
 4. The removal and temporary storage of this equipment will be on-site. The Contractor shall be responsible for transportation and any damage to the items during this process.
- C. Gypsum Board:
 1. Sand to feather edges smooth with adjacent surfaces.
 2. Repair cracks and voids and spot prime. Coordinate with drywall installer as required.
 3. Provide solvent wash for areas with greasy markings.
 4. Provide detergent where required for adhesion of paint.
 5. Remove sand, dust, dirt, oil, grease, wax, silicone, glue, and all other foreign matter.
 6. Any defects apparent before and after the primer coat has been applied shall not be the responsibility of the Painting Contractor.
 7. The resulting surface must be made acceptable to the Painting Contractor before application of the finish coat(s).
- D. Steel Substrates: Clean ungalvanized ferrous metal surfaces that have not been shopcoated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council (SSPC) specification SSPC-SP 10 and written instructions of paint manufacturer.
 1. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 2. Touch up bare areas and shop-applied prime coats that have been damaged. Wirebrush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
- E. Galvanized-Metal Substrates: Clean galvanized surfaces with nonpetroleum-based solvents so that the surface is free of oil and surface contaminants. Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
 1. Treat exterior galvanized surfaces according to SSPC SP-7 and interior galvanized surfaces to SSPC SP-1.

3.4 PRIME COATS

- A. Before application of finish coats, apply prime coat(s) as recommended by the manufacturer

to the material required to be painted or finished, and has not been prime coated by others. Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in the first coat to assure a finish coat with no burn-through or other defects due to insufficient sealing.

- B. Apply primers to metal surfaces in the field under any of the following circumstances:
 - 1. Where it can be established that shop primer was applied more than 30 days (7 days for some primers, verify with metal shop) before delivery to the site.
 - 2. If shop-applied primer is contaminated during transport or storage.
 - 3. If salts are deposited from marine fog, road salts, construction dusts, etc. during storage.

3.5 MATERIALS PREPARATION

- A. Carefully mix and prepare paint materials according to manufacturer's directions.
- B. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
- C. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.
- D. Use only thinners approved by the paint manufacturer and only within recommended limits.

3.6 APPLICATION

- A. General: Apply paint according to manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.
- B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
- C. Paint colors, surface treatments, and finishes are indicated in the schedules.
- D. Provide finish coats that are compatible with primers used.
- E. The number of coats and the film thickness required are the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce a smooth even surface according to the manufacturer's directions.
 - 1. Slightly vary the color of succeeding coats.
 - a. Do not apply additional coats until the completed coat has been inspected and approved.
 - b. Only the inspected and approved coats of paint will be considered in determining the number of coats applied.
 - 2. Sand and dust between coats to remove defects visible to the unaided eye from a distance of 5 feet.
 - 3. On removable panels and hinged panels, paint the back sides to match the exposed sides.
- F. Apply additional coats if undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.
- G. Paint surfaces behind movable equipment and furniture the same as similar exposed

surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.

- H. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
- I. Paint visible surfaces of ducts where visible through registers or grilles with a flat, nonspecular black paint.
- J. Do not paint fire-treated plywood backboards to be used for telephone or electrical equipment unless permitted by authorities having jurisdiction. Mask UL markings before painting to ensure they remain visible in the finished work.
- K. Finish exterior doors on tops, bottoms, and side edges same as exterior faces.
- L. Omit primer on metal surfaces that have been shop-primed and touch-up painted.

3.7 SCHEDULING PAINTING

- A. Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- B. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

3.8 APPLICATION PROCEDURES

- A. Apply paints and coatings by brush, roller, spray, or other applicators according to the manufacturer's directions.
- B. Brushes: Use brushes best suited for the material applied.
- C. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
- D. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
- E. Minimum Coating Thickness: Apply materials no thinner than the manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.
- F. Block Fillers: Apply block fillers to concrete and CMU at a rate to ensure complete coverage with pores filled.
- G. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime-coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- H. Miscellaneous Surfaces and Procedures
 - 1. Exposed mechanical items
 - a. Finish electric panels, access doors, conduits, pipes, ducts, grilles, registers, vents, and items of similar nature to match the adjacent wall and ceiling surfaces, or as directed.
 - b. Paint visible duct surfaces behind vents, registers, and grilles flat black.
 - c. Wash metal with solvent, prime, and apply 2 coats of alkyd enamel.

2. Exposed pipe and duct insulation
 - a. Apply 1 coat of latex paint on insulation which has been sized or primed under other Sections; apply 2 coats on such surfaces when unprepared.
 - b. Match color of adjacent surfaces.
 - c. Remove band before painting, and replace after painting.
 3. Hardware
 - a. Paint prime coated hardware to match adjacent surfaces.
 - b. Paint metal portions of head seals, jamb seals, and astragal seals to match the color of the door frame unless otherwise directed by the CITY ENGINEER.
 4. Wet areas
 - a. For oil base paints, use 1 percent phencimercuric or 4 percent tetrachlorophenol.
 - b. For water emulsion and glue size surfaces, use 4 percent sodium tetrachlorophenate.
 5. Exposed Vents: Apply 2 coats of heat resistant paint approved by the CITY ENGINEER
- I. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with specified requirements.

3.9 CLEANING

- A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
- B. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.
- C. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal.

3.10 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to CITY ENGINEER.
- B. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
- C. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.11 PAINT SYSTEMS SCHEDULES

- A. Schedule: Only major areas are scheduled. Treat miscellaneous and similar items and areas within room or space with similar system.
- B. Number of Coats: Where number of coats are specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to CITY, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.

- C. Systems Specifications: These specifications are a guide and are meant to establish procedure and quality. Confer with CITY ENGINEER to determine exact finish desired.
- D. Acceptance of Final Colors: Do not apply final coats of paint for either exterior and interior systems until colors have been accepted by CITY ENGINEER.
- E. Painted surfaces shall be considered unacceptable, as judged solely by the CITY ENGINEER, if any of the following are evident under natural lighting source for exterior surfaces and final lighting source (including daylight) for interior surfaces:
 - 1. Visible defects are evident on vertical surfaces when viewed at normal viewing angles from a distance of not less than 39-inches (1000 mm).
 - 2. Visible defects are evident on horizontal surfaces when viewed at normal viewing angles from a distance of not less than 39-inches (1000 mm).
 - 3. Visible defects are evident on ceiling, soffit and other overhead surfaces when viewed at normal viewing angles.
 - 4. When the final coat on any surface exhibits a lack of uniformity of color, sheen, texture, and hiding across full surface area.
 - 5. Coating exhibits lack of full adhesion to surfaces, including but not limited to bubbling, peeling, chipping, and other adhesion defects.
- F. Finish Schedules: References used in the schedules are based on systems described in the Painting and Decorating Contractors of America, Master Painters Institute, Architectural Painting Specification Manual (MPI).

3.12 EXTERIOR FINISH SCHEDULE – AS INDICATED ON DRAWINGS

3.13 INTERIOR FINISH SCHEDULE – AS INDICATED ON DRAWINGS

END OF SECTION 099100

SECTION 09 91 13 – EXTERIOR PAINTING AND STAINING

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Exterior Painting and Staining installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Painting and staining of all exterior surfaces including, but not limited to, the following:
 - a. Exterior ferrous metals.
 - b. Exterior galvanized metal surfaces.
 - c. Exterior wood surfaces.
 - d. Exposed piping, conduits, etc.
 - e. Concrete Masonry Units
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 05 00 00 – Metal Fabrications.
 - 2. Section 06 20 13 – Site Carpentry.
- D. Materials NOT to be Painted nor Stained:
 - 1. Following surfaces are not to receive painter's finishes:
 - a. Work having complete factory finish other than prime coat.
 - b. Stainless steel and plated finishes (not zinc or cadmium).
 - c. Walking surfaces.
 - d. Adjoining finished surfaces (plaster, precast concrete, etc.).
 - e. Work specified not to be painted under other Sections.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. SSPC – The Society for Protective Coatings.
 - 4. NPCA – National Paint & Coatings Association.
- B. Definitions:
 - 1. General: Standard coating terms defined in ASTM D16 apply to this Section.
 - 2. Standard gloss ranges (per NPCA):
 - a. Flat: A lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - b. Eggshell: A low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - c. Semi-gloss: A medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.

- d. Full gloss: A high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

3. SUBMITTALS

- A. General: Submit each item in this Article in four (4) bound Submittal Booklets and provide four (4) sets of Material Samples for review by the Landscape Architect.
- B. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- C. Product/Material Data: Prior to Submittal of Color and Gloss Material samples, submit for approval complete list of paint and stain materials proposed for use, identifying each material by manufacturer's name, product name and number, including primers, thinners, and coloring agents. Submit manufacturer's catalog data fully describing each material as to contents, recommended usage, and preparation and application methods. Identify surfaces to receive paint and stain materials. Make no deviations from approved list. If applicable, provide a chart for comparison of manufacturer's numbers as herein specified to types of paint proposed for use.
- D. Color and Gloss Material Samples: Obtain color and gloss selections and instructions from Landscape Architect. Using materials from the approved list, prepare and submit 8-1/2" x 11" samples of each complete paint and stain finish.
- E. Extra Paint and Stain: Provide Owner with ten (10) gallons of each type and color and gloss combination of paint and stain used on exterior as indicated on Contract Drawings. Provide in manufacturer's sealed containers, labeled with specific contents.
- F. Field-Constructed Mock-ups:
 - 1. Provide a paint and stain finish system sample panel for all respective materials receiving finishing which is to be used as the basis for judging quality of workmanship throughout the project.
 - 2. Prepare surfaces and apply specified finish in accordance with specified requirements.
 - 3. Apply colors selected by Landscape Architect for each designated surface.
 - 4. Prepare required samples on exterior surfaces at locations selected by the Architect. Each sample panel shall be fifty square-feet (50 SF) minimum or as directed by the Owner.
 - 5. Notify Architect when sample panels are ready for review.
 - 6. Modify or correct Work as directed by Architect.
- G. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Fabricated Metal installations.
- H. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- I. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.

4. QUALITY ASSURANCE AND CONTROL

- A. Applicable Code: California Building Code, latest edition.
- B. Installer Qualifications:
 - 1. Requirement: Valid California C-33 (Painting and Decorating Contractor) License.
 - 2. Engage an experienced Installer who has demonstrated completed exterior Painting and Staining Work similar in material, design, and extent to that indicated for this Project, with a record of successful performance, and with sufficient production capacity to complete Work without causing delay in the Work.
- C. Environmental Regulations: Conform to all applicable environmental regulations of all governing jurisdictions.
- D. Conform to requirements and specifications of WIC (WorkCover Industry Classification) Section 5 for staining and finishing of woodwork for Premium quality and to achieve uniformity of tone and color per Owner's approval.
- E. Single-Source Responsibility: Obtain basecoat and finish materials from a single manufacturing source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.

5. DELIVERY, STORAGE, AND HANDLING

- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft and damage.
- B. Deliver manufactured materials in original, unopened packages or containers with manufacturer's labels intact and legible.
- C. Store materials off ground and under cover, away from damp surfaces and inclement weather.
 - 1. Provide adequate ventilation for combustible materials.
 - 2. Empty containers, and remove oily rags at end of each day's Work.
 - 3. Exercise every precaution to prevent fire.
- D. Deliver and install materials so as to not delay Work, and install only after preparation for installation have been completed.

6. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Perform finishing operations only when weather is suitable in accordance with locally accepted practices.
- C. Construction Site Observations: Periodic site observations shall be made by the Architect during the installation of Work under this Section for compliance with requirements. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective Work under this Section at any time during progress of Work. Contractor shall request, in writing, at

least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. MATERIALS

- A. Provide materials of types as specified on the Contract Drawings and as indicated herein this Section. Provide paint and stain materials as indicated under "Painting/Staining Schedule".

3.EXECUTION

1. CONDITIONS OF SURFACES

- A. Examination of Surfaces: Examine surfaces to be finished under this Section and verify that Work of other trades has been left or installed in satisfactory conditions to receive paint, stain or specified finishes. Before starting Work, notify Landscape Architect in writing of any surfaces unsatisfactory for proper finishing. Application of first coat of any finishing process constitutes acceptance of surface.

2. PREPARATION

- A. Properly prepare surfaces to receive finishes indicated, scheduled and specified.
- B. Shop-Coated Metal: Thoroughly degrease and clean all foreign matter. Clean and spot paint field connections, welds, soldered joints, burned or abraded portions with same material used in shop coats.

- C. Uncoated Ferrous Metal: Thoroughly degrease and clean dirt, rust, mill scale and foreign matter, using rotary brushes, solvent or sandblasting as necessary. Remove pits and welding slag, and clean to bright metal before priming. Apply primer within three (3) hours after preparation.
- D. Galvanized Metal and Zinc Alloy: Thoroughly degrease and clean off foreign matter. Apply phosphoric metal etch or vinyl-type wash coat of type recommended by primer manufacturer, allow to dry and immediately apply primer paint.
- E. Wood: Remove all marks or effects of exposure with a thorough final sanding of all exposed surfaces using 150 grit or finer sandpaper. Thoroughly dust and clean prior to applying finish. Prior to installation, back-stain concealed surfaces.
- F. Surfaces Not Mentioned: Prepare in accordance with paint manufacturer's recommendations and as approved.

3. FIELD QUALITY CONTROL

- A. Application: Unless otherwise specified, apply materials in accordance with manufacturer's instructions by brush, rollers or spray. Apply each coat at proper consistency, free of brush or roller marks, sags, runs, or any other evidence of poor work quality. Avoid lapping paint on hardware, and other surfaces not to be painted; apply masking as required.
- B. Protection: Protect pavements, fixtures, equipment, and like surfaces with impervious protective covers or drop cloths. Exercise care to prevent paint or stain from being splattered onto surfaces not to be painted or stained. Paint or repaint (or stain and re-stain) surfaces from which such paint or stain cannot be satisfactorily removed, as required to produce acceptable finish.
- C. Contrasting Colors: Where painting is executed in contrasting colors, as applicable, cut to meet true lines. Holidays and re-strikes on painted surfaces are sufficient cause for necessitating recoating entire surface involved.
- D. Workmanship: Workmanship shall be first class throughout, and free of hammer marks, dents or other disfiguration. Unless otherwise specified, lumber shall not show saw marks.
- E. Barricades: Maintain barricades and wet paint signs for duration of need.

4. COATS AND COLORS

- A. Numbers of coats specified to be applied are indicated as minimum applications. First coat may be omitted on surfaces already painted; spot or undercoat with specified first coat as necessary to achieve specified results. Insure acceptable paint finishes of even, uniform color, free from cloudy or mottled appearance in surfaces and evident thinness of coating.

5. PROTECTION

- A. Protect Work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Landscape Architect.

- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their Work.
- C. After Work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

6. CLEANING AND TOUCH-UP WORK

- A. Make detailed inspection of stain / paint finishes after finishing Work is completed, carefully remove splattering of paint and stain materials from adjoining Work of others, particularly electrical fixtures, trim, tile, and finish metal surfaces, and make good any damage thereto. Repair any abraded, stained or otherwise disfigured painting/staining Work and leave entire painting/staining Work in new conditions.

7. PAINTING/STAINING SCHEDULE

- A. General: Paint or stain finish surfaces for materials or surfaces are indicated on the Contract Drawings and/or specified herein. To designate type and quality of paint, product numbers and designations used are products as indicated. Specialty products are also indicated by special product designations.

Concrete/Stucco/Masonry (other than Concrete Unit Masonry)				
Flat Acrylic Finish				
Primer	Exterior concrete and masonry primer			
Finish Coats (2)	Exterior flat acrylic paint			

a.

- B. Concrete Unit Masonry (CMU): Provide the following finish systems over exterior concrete unit masonry:

1. Flat Acrylic Finish: Two (2) finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Exterior flat acrylic paint.
 2. Eggshell Acrylic Finish: Two (2) finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Exterior Eggshell acrylic paint.
 3. Semi-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Exterior semi-Gloss acrylic enamel.
 4. Full-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a block filler.
 - a. Block Filler: Concrete unit masonry block filler.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
- C. Smooth Wood: Provide the following finish systems over smooth wood siding, wood trim, and other smooth exterior wood surfaces: <<<SELECT>>>
1. Flat Acrylic Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior flat acrylic paint.
 2. Eggshell Acrylic Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior Eggshell acrylic paint.
 3. Semi-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior semi-gloss acrylic enamel.
 4. Full-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
 5. Full-Gloss Alkyd-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for alkyd enamels.
 - b. Finish Coats: Exterior full-gloss alkyd enamel.
- D. Wood Trim: Provide the following finish systems over exterior wood trim: <<<SELECT>>>
1. Semi-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior semi-Gloss acrylic enamel.
 2. Full-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood primer for acrylic enamels.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for concrete, masonry, and wood.
 3. Full-Gloss Alkyd-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior wood trim primer for full-gloss alkyd enamels.
 - b. Finish Coats: Exterior full-gloss alkyd enamel.
- E. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items. <<<SELECT>>>
1. Eggshell Acrylic Finish: Two (2) finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coat: Exterior Eggshell acrylic paint.
 2. Semi-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior Semi-gloss acrylic enamel.
 3. Full-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
 4. Full-Gloss Alkyd-Enamel Finish: Two (2) finish coats over a rust-inhibitive primer.

- a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior full-gloss alkyd enamel.
- F. Zinc-Coated Metal: Provide the following finish systems over exterior zinc-coated metal surfaces: <<<SELECT>>>
- 1. Eggshell Finish: Two (2) finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coat: Exterior Eggshell acrylic paint.
 - 2. Semi-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior Semi-gloss acrylic enamel.
 - 3. Full-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
 - 4. Full-Gloss Alkyd-Enamel Finish: Two (2) finish coats over a galvanized metal primer.
 - a. Primer: Exterior galvanized metal primer.
 - b. Finish Coats: Exterior full-gloss alkyd enamel.
- G. Aluminum: Provide the following finish systems over exterior aluminum surfaces: <<<SELECT>>>
- 1. Semi-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior aluminum primer under acrylic finishes.
 - b. Finish Coats: Exterior Semi-gloss acrylic enamel.
 - 2. Full-Gloss Acrylic-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior aluminum primer under acrylic finishes.
 - b. Finish Coats: Exterior full-gloss acrylic enamel for ferrous and other metals.
 - 3. Full-Gloss Alkyd-Enamel Finish: Two (2) finish coats over a primer.
 - a. Primer: Exterior aluminum primer under alkyd finishes.
 - b. Finish Coats: Exterior full-gloss alkyd enamel.

END OF SECTION 09 91 13 – EXTERIOR PAINTING AND STAINING

SECTION 09 96 23 - GRAFFITI-RESISTANT COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2

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

1.3 SECTION INCLUDES

- A. Non-sacrificial graffiti-resistant and water repellent coating system applied to the following painted or un-painted substrates:
 - 1. Concrete and Portland cement plaster.
 - 2. Galvanized steel.
 - 3. Painted metal.
 - 4. Minimum Coverage: As indicated on Drawings.

1.4 SYSTEM DESCRIPTION

- A. Complete graffiti-resistant system includes the following:
 - 1. Base coat.
 - 2. Top coat.
 - 3. Cleaner (graffiti remover).
- B. Properties:
 - 1. Zero VOC.
 - 2. 20-25 years life expectancy.
 - 3. Permanent coating.
 - 4. Withstands excessive removals.
 - 5. FDA/USDA, State and City approved.
 - 6. Non-Yellowing, non-chalking.
- C. Performance requirements for the applied graffiti-resistant system:
 - 1. Show no signs of deterioration or change of appearance after graffiti materials removal during the warranty period.
 - 2. Withstand 100 percent removal of all types of paint and graffiti materials without damaging the coating or the substrate. No evidence of graffiti shall remain on the surface.
 - 3. Withstand a minimum of 200 cleaning cycle without measurable coating deterioration.

1.5 ACTION SUBMITTALS

- A. Product Data: Submit manufacturer's product data sheets for all products to be used for the work, including installation instructions, physical, chemical, and graffiti-resistant

properties. Submit description for protection of surrounding surfaces not scheduled to receive coating, surface preparation, application, and final cleaning.

- B. Samples: Manufacturer's color charts showing the full range of colors available for each type of finish-coat material indicated.

1.5 INFORMATIONAL SUBMITTALS

- A. Application Qualifications: Submit qualifications for applicator as follows:
 - 1. Certification stating applicator is experienced in the application of the specified products.
 - 2. List of recently completed graffiti-resistant coating projects, including project name, location, name of owner and architect, description of product used, substrates, applicable local environmental regulations, and application procedures.
- B. VOC Certification: Submit certification that graffiti-resistant coatings furnished comply with regulations controlling use of volatile organic compounds.
- C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Project Closeout Submittals: Submit to CITY ENGINEER upon completion of project maintenance information on method of removing graffiti. Include name, address, and phone number of nearest service representative.
- B. Warranty: Executed special warranty specified in this Section.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish one identified unopened 5-gallon container of each coating used, and cleaning agent in quantity equal to twelve 16-ounce bottles to be used for graffiti removal.
- B. Provide the CITY ENGINEER copy of instructions for graffiti removal using specified manufacturer's product, and maintenance recommendations.
- C. Coating and cleaning agent shall not be used for re-coating or touching-up damaged surfaces before final acceptance of the work.
- D. Deliver materials and an inventory list just prior to Substantial Completion and store where directed by the CITY ENGINEER.

1.8 QUALITY ASSURANCE

- A. Applicator Qualifications: Installation shall be performed by applicators with satisfactory experience in the application of the material to be used and trained for the application of the specified coating materials.
- B. Pre-installation Meeting: Convene a pre-installation meeting one week before the start of application of graffiti resistant coatings. Require attendance of parties directly affecting the work of this section, including the Contractor, CITY ENGINEER, applicator and his foreman, and manufacturer's representative. Items to review include, but are not limited to the following:
 - 1. Environmental regulations.

2. Test panel procedures.
3. Protection of surrounding areas not scheduled to receive coating.
4. Surface preparation.
5. Application procedures.
6. Field quality control.
7. Final cleaning.
8. Coordination with other work.
9. Final approval of finishes will be made from benchmark samples.
- C. Coordination: Coordinate related trades for installation of the Work. Advise brick and plaster trades on proper cleaning and protection of their materials for successful application of graffiti resistant coating.
- D. Test Panel Mock-ups:
 1. Before proceeding with full-scale application, review manufacturer's product data sheet to determine the suitability of product for the specific surfaces. Apply coating to test panel at the jobsite to determine number of applications, coverage rates, compatibility, effectiveness, surface preparation, application procedures, and desired results.
 2. Apply graffiti-resistant coating to test panels in accordance with manufacturer's written instructions. Allow 48 hours or until test panels are thoroughly dry before evaluating final appearance and results. Do not begin full-scale application until test panels are approved by the CITY ENGINEER.
 3. Test Panel Requirements:
 - a. Size: Minimum 4- x 4-feet each, or as determined by CITY ENGINEER.
 - b. Locations: As determined by CITY ENGINEER.
 - c. Number: as required to completely test each coating application method with each type of substrate to be protected.
 4. Retain and protect test panels approved by the CITY ENGINEER in undisturbed condition during the work of this Section for use as a standard for judging the final graffiti-resistant coating work.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to the Project site in manufacturer's original unopened containers and packaging with labels identifying product name and manufacturer and the following:
 1. Name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Handling instructions and precautions
- B. Store containers in a cool, dry, well-ventilated place, away from heat. Store away from all other chemicals and potential sources of contamination. Keep lights, fire, sparks, and heat away from containers. Do not drop containers or slide across sharp objects. Keep containers tightly closed when not in use. Store and handle materials in accordance with manufacturer's written instructions.
 1. Keep storage area neat and orderly. Remove oily rags and waste daily. Take

necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and applying coatings.

1.11 SITE CONDITIONS

- A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 40 deg and 90 deg F during application and for a minimum of eight hours after application, unless otherwise indicated in manufacturer's written instructions.
- B. Wind Conditions: Do not apply under windy conditions such that the graffiti-resistant coating may be blown to surfaces, either on site or off, not intended to be treated.
- C. Rain Conditions: Do not apply earlier than 24 hours after rain or if rain is predicted for a period of 8 hours after application, unless otherwise indicated in manufacturer's written instructions.

1.12 WARRANTY

- A. Warrant graffiti-resistant coatings to be free from defects in material, fabrication, and installation. Graffiti-resistant coatings shall continue to repel graffiti after repeated cleaning during the warranty period.
 - 1. Defects are defined to include failure to withstand complete graffiti removal, ghosting, shadowing, chemical staining, yellowing, and normal environmental effects.
 - 2. Protection against future graffiti shall remain intact without need to re-apply any top coat or other coatings.
 - 3. This warranty shall be in addition to and not a limitation of other rights the CITY may have against the Contractor under the Contract Documents.
 - 4. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Provide graffiti-resistant coating system complying with the following:
 - 1. Permanent coating system. Coating shall not require re-application regardless of number of graffiti taggings during the life of the 10-year performance warranty period.
 - 2. Show no signs of deterioration or change of appearance after graffiti removal during the warranty period. No ghosting, staining or shadowing.
 - 3. Capability of removing 100-percent of all types of paint and graffiti materials from treated surfaces without damaging the coating or the substrate.
 - 4. Upon graffiti removal, no evidence of graffiti shall remain.
 - 5. Capable of withstanding a minimum of 120 cleaning cycles over the same area without measurable coating deterioration.
 - 6. Shall not increase dirt pick-up of substrate.
 - 7. Meet the following test results for the following chemicals:
 - a. MEK No effect after 5-days.

- b. Carboxylic Acid No effect after 5-days.
 - c. 75% Phosphoric Acid No effect after 5-days.
 - d. 37% HCL 3 hours blister.
 - e. 50% Sulfuric Acid No effect after 5-days.
 - f. 20% NIT 68 hours blister.
- B. Time-Tested:
 - 1. Graffiti resistant system shall have been in successful commercial use for at least 12-years.
 - 2. Furnish documentation of performance of the graffiti-resistant coating system by written report from a nationally recognized and certified protective coating specialist. Documentation shall include type of substrate, location, length of service, testing performed and results.

2.2 MATERIALS, GENERAL

- A. Material Characteristics: ASTM D6578/D6578M; and the following:
 - 1. Silicone elastomer graffiti control coating.
 - 2. Compliant with California VOC regulations.
 - 3. Clear, single component.
 - 4. Non-yellowing.
 - 5. Non-glossy penetrating liquid forming a durable invisible barrier.
 - 6. Specifically designed for porous masonry and plaster to provide protection against water and waterborne staining.
 - 7. Vapor permeable.
 - 8. Non-sacrificial type coating.
 - 9. Efflorescence-inhibiting.
- B. Material Quality: Provide manufacturer's best-quality material for each coating material specified.

2.3 COATING SYSTEM

- A. Pre-treatment:
 - 1. Galvanized steel: Metal Etch by Monopole, water-reducible phosphoric and nitric acid for cleaning and preparation of galvanized metal surfaces. VOC <Zero.
 - 2. Sealer for plaster, concrete and CMU surfaces: Aquaseal ME 12 by Monopole, clear flat, silane/siloxane oligomeric penetrating water repellent sealer. VOC <32g/L.
- B. Base coat: Permashield Base by Monopole, clear, single component, hydrophobic, waterbased acrylic urethane, designed to provide a pin-hole free coating on natural substrate surfaces. VOC <50 g/L.
- C. Top coat: Permashield Premium by Monopole, clear, 2 component, water base, aliphatic polyurethane top coat with matt finish. VOC <Zero.

2.4 CLEANER (GRAFFITI REMOVER)

- A. Citrus Clean Super by Monopole, biodegradable, water based cleaner/remover.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the conditions and surfaces on which the coating is to be applied. Do not proceed with the Work until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Protect surrounding areas, landscaping, pedestrians, vehicles, and other surfaces not designated to receive coating during the work from contact with graffiti-resistant coatings, masonry or concrete cleaners if used, residues, rinse water, fumes, wastes, and effluents in accordance with manufacturer's written instructions.
- B. Protect surrounding painted surfaces, metal, glass, foliage, and items from damage due to contact with graffiti coatings, in accordance with manufacturer's written recommendations.
- C. Clean all dirt, dust, oil, grease, and other contaminants from surfaces that interfere with penetration or performance with graffiti-resistant coatings. Use appropriate masonry or concrete cleaners approved by the graffiti-resistant coating manufacturer where necessary. Rinse thoroughly using pressure water spray to remove cleaner residues. Allow surfaces to dry completely before application of graffiti-resistant coatings.
- D. Repair, patch, and fill all cracks, voids, defects, and damaged areas in surfaces as approved by the CITY ENGINEER. Allow repair materials to cure completely before application of graffiti-resistant coatings.
- E. Apply specified sealants and allow to cure completely before application of coating.
- F. Seal all open joints.
- G. Allow repointed surfaces to cure completely before application of coating.

3.3 APPLICATION

- A. General: Application of coatings indicates Applicator's acceptance of surfaces and conditions.
- B. Apply graffiti-resistant coatings to substrates in accordance with the manufacturer's written instructions, environmental regulations, and application procedures determined from test panel results approved by the CITY ENGINEER.
- C. Apply to clean, dry, cured, and properly prepared surfaces.
- D. Consult manufacturer's written instructions for information on application equipment to be used and precautions to be taken with the specified products.
- E. Do not dilute or alter graffiti-resistant coatings. Apply as packaged.
- F. Do not apply graffiti-resistant coatings to the following surfaces:
 - 1. Horizontal or below-grade surfaces.
 - 2. Asphalt or other non-masonry materials.
 - 3. Painted or factory-finished surfaces.
- G. Do not apply to compensate for structural or material defects in substrates.
- H. Avoid overspray, wind drift, and splash of graffiti-resistant coatings.
- I. Application over Cementitious Surfaces:

1. All natural surfaces including concrete, masonry units, brick tile and block shall be treated with a siloxane penetrating water sealer compatible with the graffiti solution system.
 2. Base: Minimum of 2 coats or as required to achieve a pinhole free surface, of specified barrier coating, 3- to 4-mils minimum dry film thickness.
 3. Finish: Minimum 2 coats of top coating, 3- to 4-mils minimum dry film thickness or as required to comply with specified warranty requirements.
- J. Application over Metal Surfaces:
1. Finish: 2 coats of top coating, 3- to 4-mils minimum dry film thickness.
- K. Completed Work: Match approved samples and mock-up for color, texture and coverage. Remove, refinish, or recoat work that does not comply with specified requirements.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services: Obtain the services of a manufacturer's authorized field representative to verify protection, surface preparation, and application of graffiti-resistant coatings are in accordance with the manufacturer's written instructions and the test panel results approved by the CITY ENGINEER.
- B. The CITY ENGINEER reserves the right to invoke the following procedure at any time and as often as CITY ENGINEER deems necessary during the period when coatings are being applied:
1. CITY ENGINEER will engage the services of a qualified testing agency to sample coating material being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of the Contractor.
 2. Testing agency will perform appropriate tests for the following characteristics as requested by the CITY ENGINEER:
 - a. Quantitative materials analysis.
 - b. Absorption.
 - c. Accelerated weathering.
 - d. Accelerated yellowness.
 - e. Alkali and mildew resistance.
 - f. Abrasion resistance.
 - g. Washability.
 3. CITY ENGINEER may direct Contractor to stop applying coatings if test results show materials being used do not comply with specified requirements. Remove noncomplying coating materials from the Project site, pay for testing, and recoat surfaces coated with rejected materials. If necessary, remove rejected materials from previously coated surfaces if, on recoating with specified materials, the two coatings are not compatible.

3.5 ADJUSTING

- A. Remove from the site and dispose of all materials used to protect surrounding areas and nonmasonry surfaces following completion of the Work. Discard coating materials, rubbish, cans and rags at the end of each work day.
- B. Repair, restore, or replace to the satisfaction of the CITY ENGINEER, all materials, landscaping, and non-masonry surfaces damaged by exposure to coatings.

3.6 CLEANING

- A. Clean site of all unused coatings, residues, rinse water, wastes, and effluents in accordance with environmental regulations.
- B. Upon completion of Work, clean coating-splattered surfaces. Remove splattered coating by proper methods of washing, using care not to scratch or otherwise damage finished surfaces.
- C. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

3.7 DEMONSTRATION

- A. Demonstration: Apply alkyd-based graffiti to a 2-foot square treated area selected by the CITY ENGINEER. Allow graffiti to remain on surface for a minimum of 5-days and demonstrate complete removal in the presence of the CITY ENGINEER.

END OF SECTION 099623

DIVISION 10

Specialties

SECTION 10 14 00 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY OF WORK

- A. This project is required to be Leadership in Energy and Environmental Design (LEED®) NCv4 certified at Gold level. Certain designated credits will be pursued per the requirements of LEED-NC v4.1 and addenda current as of April 2021. See section 018113 "Sustainable Design Requirements" for related product and procedure requirements, references, definitions, documentation requirements, action plans, meetings, and performance requirements of products and systems which relate to the scope of all designers, contractors, and suppliers.
- B. Work consists of providing labor, materials, equipment, services, and administration required in conjunction with or properly incidental to Project construction.
- C. Work comprises of color and material samples, shop drawings, fabrication and installation of all sign types.
 - 1. Sign Type A: Exterior Signs
 - 2. Sign Type B: Wayfinding / Information Signs
 - 3. Sign Type C: Code Required Signs
- D. Engineering and Sign Permitting where applicable

1.2 MANUFACTURES QUALIFICATIONS

- A. Sign manufacturer shall provide evidence that they regularly and presently manufacture signs similar to those specified in this section as one of their principal products.
- B. Sign Contractors License.

1.3 WORK RESTRICTIONS

- A. Limit use of premises for Work, storage, and access to allow:
 - 1. Work by other contractors.
 - 2. Public usage.
- B. Assume responsibility for protection and safekeeping of products stored on site under this Contract.
- C. Move stored products which interfere with operations of Owner or separate contractors.
- D. Conduct operations to ensure least inconvenience to public, other building tenants, and to occupied areas.
- E. Obtain and pay for use of additional storage or staging areas needed for operations.
- F. Do not load structure with weight that would jeopardize its safety.
- G. Should it be necessary to use portions of existing streets, sidewalks or right of ways for operations, obtain approval and pay for use of such areas in accordance with requirements of authorities having jurisdiction.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's construction details relative to materials, dimensions of individual components, sections, and samples for each type of sign required.
- B. Shop Drawings: Furnish shop drawings for fabrication and installation of signs. Include plans, elevations, and large-scale sections of typical members, methods of fastening and other components. Methods of fastening shall be detailed and exact specifications for all fasteners shall be indicated on shop drawings.
- C. For signs supported by or anchored to permanent construction, furnish setting drawings, templates, and directions for installation of anchor bolts and other anchors.
- D. The following samples to be provided to CITY ENGINEER:
 - 1. One full size partial sample of digital print graphics.
 - 2. One full size sample of typical room sign with specified material and finish.
 - 3. One full size sample of code sign with specified material and finish
 - 4. One sample of all exposed hardware and fasteners
 - 5. 6"x6" samples of each color and material

1.5 REGULATORY REQUIREMENTS

- A. Signage shall comply with all applicable California Building Code (CBC) and California Fire Code (CFC) signage requirements.
- B. Signs shall comply with CBC Section 11B-703. Where both visual and tactile characters are required, either one sign with both visual and tactile characters, or two separate signs, one with visual, and one with tactile characters, shall be provided.
- C. 11B-703.2 Raised Characters, Raised characters shall comply with Section 11B-703.2 and shall be duplicated in Braille complying with Section 11B-703.3. Raised characters shall be installed in accordance with Section 11B-703.4.
- D. 11B-703.3 Braille, Braille shall be contracted (Grade 2) and shall comply with Sections 11B-703.3 and 11B-703.4. Braille dots shall have domed or rounded shape.
- E. 11B-703.4 Installation Height and Location. Signs with tactile characters shall comply with Section 11B-703.4.
- F. 11B-703.5 Visual Characters. Visual characters shall comply with Section 11B-703.5.
- G. 11B-703.6 Pictograms. Pictograms shall comply with Section 11B-703.6.
- H. 11B-703.7 Symbols of Accessibility. Symbols of accessibility shall comply with Section 11B-703.7.
- I. 11B-703.8 Variable Message Signs. High resolution variable message sign (VMS) characters shall comply with Sections 11B-703.5 and 11B-703.8.12 through 11B-703.8.14. Low resolution variable message sign (VMS) characters shall comply with Section 11B-703.8. 11B-216 Signs. New or altered signs shall be provided in accordance with Section 11B-216 and shall comply with Section 11B-703. (Refer to CBC Section 11B-216)
- K. 1009.9 Signage. Signage indicating special accessibility provisions shall be provided as shown: Each door providing access to an area of refuge from an adjacent floor area shall be identified by a sign stating: AREA OF REFUGE.
- L. 1013.4 Raised Character and Braille Exit Signs. Raised character and Braille exit signs shall comply with Chapter 11A, Section 1143A or Chapter 11B, Sections 11B-703.1, 11B-703.2, 11B-703.3 and 11B-703.5.
- M. 1001.4 Fire Safety and Evacuation Plans. Fire safety and evacuation plans shall be

provided for all occupancies and buildings where required by the California Fire Code. Such fire safety and evacuation plans shall comply with the applicable provisions of Sections 401.2 and 404 of the California Fire Code.

- N. CFC Section 505 Premises Identification. Shall comply with 505.1 Address Identification.

PART 2 - - PRODUCTS

2.1 MATERIALS

- A. Non-Glare Acrylic sheeting
- B. Adhesives: Silicone adhesive, used for installing signs shall be as manufactured by General Electric, Dow Corning or equal. Adhesive tape shall be industrial strength and manufactured by 3M or equal.
- C. Aluminum: Suitable for ornamental, architectural work. Surface finish shall be smooth, free of extrusion marks or imperfections. Alloy wall thickness shall be selected to meet structural, fabrication and aesthetic requirements of the specific application.
- D. Fasteners: All fasteners shall be hidden from view unless otherwise specified in design bid drawings. Fasteners or hardware used for securing signs to concrete or other structural surfaces shall be engineered to meet code requirements and comply with the design intent of the drawings.
- E. Hardware: Provide incidental hardware necessary for the proper functioning of the signs. Provide tamper-proof fastener where publicly accessible.
- F. Metal Clips, Brackets, and Reinforcements: Concealed sheet metal clips, mounting studs, brackets and reinforcements shall be of gauge required to satisfy structural and requirements, and to insure a smooth and uniform finish.
- G. Seams and Joints: Welded joints shall be ground, filled and finished flush and smooth with adjacent work. Such seams shall be invisible after final finish has been applied. Spot welded joints shall be invisible on exterior of sign after final finish has been applied. No gaps, waves or oil-canning will be permitted in the work.
- H. Anodized Aluminum & Paint Finishes: All surfaces shall be properly prepared following the recommendations of the manufacturer. Final finish shall be guaranteed for 3 years against chipping, peeling, or fading.
- I. All surfaces shall be properly prepared for paint and all paint shall be manufactured by Matthews Paint Company or equal.
- J. Wire Screen for Monument Signs: Egla-Mono 4991:
 - 1. Aperture width w: 22,5mm x 3mm
 - 2. Wire diameter d: 2,5mm x 1,4mm/2mm
 - 3. Open Area: 54%
 - 4. Weight: 6,3 kg/square meter
- K. Interpretive Sign Panel: iZone (or equal) high pressure laminated (HPL) panel.

2.2 FABRICATION REQUIREMENT

- A. Signs shall be free from burrs, dents, raw edges and sharp corners.
- B. Finish surfaces smooth unless otherwise indicated.
- C. Surfaces intended to be flat shall be free from ridges, oil-canning, gaps or other physical deformities. Surfaces shall be fabricated to remain flat under installed conditions.
- D. Surfaces intended to be curved shall be smoothly free-flowing to required shapes.

- E. Cut rounded letterforms and/or graphics clean and true to match adjacent surface-applied letterforms and/or graphics.
- F. Exercise care to protect polished surfaces so they remain unblemished in the finished work.
- G. Isolate dissimilar materials. Exercise care to isolate nonferrous metals from ferrous metals as required to prevent corrosion.
- H. Visible sign surfaces of the same type shall have the same finish. Color and/or finish shall be consistent across the entire surface of a sign.
- I. Reveals shall be uniform width. All butt joints shall be tight and closed along the entire length.
- J. Gaps between milled components, when assembled, shall not exceed a tolerance of 0.008 inch.

2.3 SIGN SUMMARY

- A. Provide shop drawings for all signs indicated on the sign document drawings.
- B. Provide layouts for all signs for final message approval.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Dimensional Letters: All cutting and routing shall be executed in such a manner that all edges of finished characters are true and clean. Characters with rounded positive or negative corners, cut or ragged edges will not be accepted. All characters shall be aligned to maintain a base line parallel to the sign format. Vertical strokes shall be plumb. Margins and letter spacing shall be maintained as indicated in the design layout.
- B. Pin Mount: Letters shall be securely pin mounted flush to wall surface with silicon adhesive.
- C. Vinyl graphics shall be applied free of bubbles, bumps, seams or tears.

3.2 FABRICATION AND INSTALLATION COORDINATION

- A. Site Conditions: Examine the site conditions, structures, substrates and other conditions under which the signs are to be installed, and notify the CITY ENGINEER of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.
- B. Installation Conditions: Sign installation shall be carried out in a neat and proper manner, equal to the highest standards of quality in craftsmanship and in service as founded in the industry. Make all provisions necessary and take precautions to protect adjacent surface finishes and landscaping from damage.
- C. Sign Location: A location plan is located on each sign type sheet to identify and locate all signs. Sign Type numbers are found on each sheet and are to identify locations of specific signs. Install sign items, including all components, per the schedule, at locations indicated. Exact sign locations and positions will be determined by CITY ENGINEER upon site

- inspection prior or during installation.
- D. Sign Position: Sign installation shall follow the elevation drawings and position standards specified. Installed signs shall be properly aligned, level and true to line and dimension.
 - E. Mechanical Fasteners: Where stud fastenings or other mechanical fasteners are used, adequate mounting shall be provided, including the use of "tamperproof" screws where necessary, to prevent unauthorized removal of sign. Fastenings, structures and units shall be structurally sound and comply with applicable code requirements and restrictions.
 - F. Installation of Individual Characters: Install units true to adjacent architectural lines, in locations and with mountings indicated. Securely attach to supporting structure with concealed fasteners using cement adhesive or clear silicone adhesive and threaded stud hardware.
 - G. Signs shall be flush to surface unless otherwise indicated, free of excess visible adhesive if used, with no damage to sign or surrounding surface, and without other imperfections.

3.3 CLEANING AND PROTECTION

- A. Sign Clean-Up and Protection: At completion of installation, remove protective coatings and identifying stickers, paper or otherwise from sign face.
- B. Sign surfaces shall be cleaned and polished. Clean sign materials using only cleaners and methods recommended by signage manufacturer. Provide CITY ENGINEER with cleaning instructions for continued maintenance of signs.
- C. Protect all sign components from damage until acceptance is obtained in writing from the CITY's Designated Representative. Any damaged signs shall be repaired to the satisfaction of the CITY's Designated Representative or shall be replaced.
- D. Site Clean-Up and Repair: Repair and repaint any buildings and/or adjacent surfaces that are damaged by sign installation. Damage to such surfaces shall be repaired to the satisfaction of the CITY's Designated Representative.
- E. Remove daily all crating and debris from the Project and leave premises in a clean condition.

3.4 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.
 - B. Warranty Period: One year from date of Substantial Completion

END OF SECTION 101400

SECTION 10 28 13 - COMMERCIAL TOILET ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SECTION INCLUDES

- A. Toilet room accessories of the following types:
 - 1. Paper towel dispenser/trash receptacles.
 - 2. Toilet seat cover dispensers.
 - 3. Toilet paper dispensers.
 - 4. Grab bars at accessible toilet stalls.
 - 5. Sanitary napkin disposals.
 - 6. Soap dispensers.
 - 7. Framed polished metal mirror units.
 - 8. Sanitary napkin vendors.
 - 9. Lavatory plumbing insulation.
 - 10. Mop and broom holders at Janitor closets.
 - 11. Diaper changing stations.
 - 12. Electric hand dryers.

1.3 ACTION SUBMITTALS

- A. Product Data: Provide for each toilet accessory item specified, including construction details relative to materials, dimensions, gages, profiles, mounting method, specified options, and finishes.
 - 1. Electric Hand Dryers: Include operating instructions.
 - 2. Motors: Show nameplate data, ratings, characteristics, and mounting arrangements.
- B. Shop Drawings: Identify where cutouts are required in other work, including templates, substrate preparation instructions, and directions for preparing cutouts and installing anchorage devices.
 - 1. Wiring Diagrams: Power, system, and control wiring.
- C. Schedule: Provide schedule of accessories for each room.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: Instructions, including replaceable parts and service recommendations.
 - 1. Electric hand dryer operator.

1.5 QUALITY ASSURANCE

- A. Inserts and Anchorages: Furnish accessory manufacturers' standard inserts and anchoring

devices that must be set in concrete or built into masonry. Coordinate delivery with other work to avoid delay.

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

1.7 SITE CONDITIONS

- A. Coordination: Coordinate accessory locations, installation, and sequencing with other work to avoid interference with and ensure proper installation, operation, adjustment, cleaning, and servicing of toilet accessory items.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Stainless Steel: AISI Type 302/304, with polished No. 4 finish, 0.034-inch (22-gage) minimum thickness.
- B. Chrome Plating: ASTM B456, Service Condition Number SC 2 (moderate service).
- C. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.
- D. Galvanized Steel Mounting Devices: ASTM A153/A153M, hot-dip galvanized after fabrication.
- E. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.2 ELECTRIC HAND DRYERS

- A. Electric hand dryers: Dyson Airblade Electric Hand Dryer, Model MK2 AB06.
 - 1. Mounting: Surface mounted on galvanized steel backplate.
 - 2. Construction:
 - a. Die cast aluminum casing with anti-microbial lacquer coating.
 - b. Provide tamper-proof M6 machine screws at locations exposed to view.
 - c. Water ingress protection to IPX5.
 - 3. Color: Silver.
 - 4. Filtration: 99.97 percent bacterial removal, HEPA filter.
 - 5. Operation: Touch-free infra-red activation.
 - a. Hand dry time: 12 seconds
 - b. Airspeed at nozzle: 420 mph
 - c. Operating airflow: 28 l/s
 - d. Rated operating noise power: 84 db(A)
 - 6. Motor: Dyson Digital Motor (DDM), V4 brushless DC motor; 92,000 rpm motor speed; less than 0.5-watt standby power consumption.
 - 7. Electrical requirements: 120-127 VAC, 1400 W.

2.3 FABRICATION

- A. General: Only a maximum 1-1/2-inch-diameter, unobtrusive stamped manufacturer logo, as approved by CITY ENGINEER, is permitted on exposed face of toilet or bath accessory units. On either interior surface not exposed to view or back surface, provide additional identification by either a printed, waterproof label or a stamped nameplate,

- indicating manufacturer's name
and product model number.
- B. Surface-Mounted Toilet Accessories, General: Except where otherwise indicated, fabricate units with tight seams and joints, exposed edges rolled. Hang doors or access panels with continuous stainless steel piano hinge. Provide concealed anchorage wherever possible.
 - C. Recessed and Semi-Recessed Toilet Accessories, General: Except where otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors or access panels with full-length, stainless steel piano hinge. Provide anchorage that is fully concealed when unit is closed.
 - D. Framed Mirror Units, General: Stainless-steel sheet with fiberboard backing; enclosed in a frame formed from 0.064-inch (1.63-mm) nominal-thickness, zinc-plated steel sheet; with round corners. Fabricate frame with welded and ground corners or from one piece of metal. Provide No. 8 finish for mirror, chrome plating for frame.
 - E. Mirror Unit Hangers: Heavy-duty wall brackets of galvanized steel, equipped with concealed locking devices requiring a special tool to remove that will permit rigid, tamperproof, and theftproof installation.
 - F. Keys: Provide universal keys for access to toilet accessory units requiring internal access for servicing, resupply, etc. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install toilet accessory units according to manufacturers' instructions, using fasteners appropriate to substrate as recommended by unit manufacturer. Install units plumb and level, firmly anchored in locations and at heights indicated.
- B. Apply sealant to perimeter between accessories and wall surface where accessory edge is permanent.
- C. Secure mirrors to walls in concealed, tamperproof manner with special hangers, toggle bolts, or screws. Set units plumb, level, and square at locations indicated, according to manufacturer's instructions for type of substrate involved.
- D. Install grab bars to withstand a downward load of at least 250 lbf, complying with ASTM F446.
- E. Electric Hand Dryers:
 - 1. Wiring Method: Install wiring in raceway. Use UL-listed cable. Conceal raceway and cables.
 - 2. Test electrically operated units to verify that dryers are in optimum functioning condition.

3.3 ADJUSTING

- A. Adjust toilet accessories for proper operation and verify that mechanisms function

smoothly. Replace damaged or defective items.

3.4 CLEANING

- A. Clean and polish all exposed surfaces strictly according to manufacturer's recommendations after removing temporary labels and protective coatings.
- B. Construction Waste Management: Manage construction waste in accordance with provisions of Section 017419 Construction Waste Management and Disposal. Submit documentation for Credit MRp2/MRc5 to satisfy the requirements of that Section.

3.5 SCHEDULE - TBD

END OF SECTION 102813

SECTION 107500 - FLAGPOLES

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Flagpole installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Cone-tapered Flagpole.
 - 2. Cast-in-place concrete, including reinforcement, for ground-set foundation sleeve anchorage and assembly.
 - 3. Supplementary parts and components, such as inserts, clips, fasteners, anchors, and other miscellaneous supports, materials, or accessories required for a complete Flagpole installation.
 - 4. Joint Sealants, as required.
 - 5. Flags, as indicated herein this Section.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 079200 – Joint Sealants.
 - 2. Section 321323 – Site Concrete.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. CBC – California Building Code.
 - 4. NAAMM – National Association of Architectural Metal Manufacturers.
- B. Definitions:
 - 1. MPH – Miles per Hour.
 - 2. PSI – Pounds per Square-Inch.
- C. Structural Performance: Provide Flagpole capable of withstanding the effects of wind loads as determined according to the Building Code in effect for this Project or NAAMM FP 1001, *"Guide Specifications for Design Loads of Metal Flagpoles,"* whichever is more stringent.
 - 1. Base Flagpole design on maximum standard-size flag suitable for use with pole or flag size indicated whichever is more stringent.
 - a. Flagged Wind Speed: At maximum 110 MPH. Manufacturer to verify wind speed with Structural Engineer of Record.
 - b. Basic Flag Size:
 - 1) Size: 5'-0" x 8'-0" (for 30' high flagpole).

3. SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Product/Material Data: Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
 - a. Flagpole, including all applicable supplementary parts and components, for a complete installation.
 - b. Manufacturer's technical information, including installation instructions and recommendations.
 - c. Related Evaluation Reports for any assembly that is considered supplement to the current prevailing building codes.
2. Structural Calculations: For the Flagpole and reinforced foundation as indicated on the, Contract Drawings, to comply with certain design loadings, include structural analysis data. Structural Calculations shall be signed and sealed by the qualified professional engineer responsible for their preparation.
3. Scaled Shop Drawings: Show general layout, jointing, grounding method, and anchoring and supporting systems.
 - a. Provide details of foundation system for ground-set poles (where required).
4. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Flagpole installations.

C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):

D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.

E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.

4. QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- B. Single-Source Responsibility: Obtain each color, type, and variety of Flagpole, within a single type of Unit, from a single source with resources to provide products and materials of consistent quality in appearance and physical properties, without delaying the Work.
- C. Source Limitations: Obtain each Flagpole as a complete Unit, from a single Manufacturer, including fittings, accessories, bases, and anchorage devices.
- D. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
- E. Field-Constructed Mock-ups: Not Required.

5. DELIVERY, STORAGE, AND HANDLING

- A. General: Spiral wrap Flagpole with heavy kraft paper or other weather-tight wrapping and enclose in a hard fiber tube or other protective container.
- B. Deliver materials in a timely manner to ensure uninterrupted progress of the Work.
- C. All Units indicated herein this Section shall be delivered, handled, and stored as necessary to prevent damage. Units shall be in “new” condition when ready for installation. It shall be the responsibility of the Contractor to install “factory condition” Flagpole furnishings.

6. COORDINATION, SCHEDULING AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Project Conditions:
 - 1. Environmental Requirements: Comply with Manufacturer’s recommendations of environmental conditions affecting product installation requirements.
 - 2. Wind and Weather Criteria:
 - a. Perform installation of Flagpole only when weather and soil conditions are suitable in accordance with locally accepted practices. Do not install Flagpole during wind, rain, lightening, or other inclement weather.
- C. Field Measurements and Conditions:
 - 1. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
 - 2. Excavation: When conditions detrimental to installing Flagpole is encountered, such as adverse drainage conditions, or obstructions, cease installation operations and notify Landscape Architect for further direction.

3. Grades and Levels: Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
 4. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic, as required, for other construction activities during installation of Flagpole. Access shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
 5. Protection: Protect adjacent finished surfaces prior to application. Maintain protection until completion of Work.
- D. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective Work under this Section at any time during progress of Work. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.
7. SUBSTITUTIONS
- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
 - B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
 - C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
 - D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. FLAGPOLE AND FITTING ACCESSORIES
 - A. Pole Construction, General: Construct Flagpole and ship to the Project Site in two (2) pieces. Provide snug-fitting precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight, hairline field joints that require no field welding.
 - B. Flagpole:
 1. Cone-tapered ground-set (embedded) Flagpole, fabricated from seamless, extruded aluminum tubing complying with ASTM B221, alloy 6063-T6, having a tensile strength not less than 30,000PSI with a yield point of 25,000 PSI, heat treated after fabrication to comply with ASTM B597, temper T6, complete with Internal Halyard System.
 - a. Exposed (nominal) Mounting Height of Flagpole:
 - 1) 30'-0".
 - b. Tapered Shaft Dimensions:

- 1) Shaft Diameter at Base: Minimum ten-inches (10").
 - 2) Shaft Diameter at Top: Minimum four-inches (4").
 - c. Minimum Wall Thickness: .365 inch.
 2. Finish: Manufacturer-applied, clear anodized finish.
 - a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products.
- C. Ground-Set Foundation Sleeve and Accessories: Hot-dipped galvanized corrugated sheet steel Foundation Sleeve tube, 0.0635-inch (16 gauge) minimum wall thickness, sized to suit Flagpole and installation.
1. Lighting Protection Rod: Manufacturer-supplied 5/8-inch diameter by four feet (4') long or 3/4-inch diameter by three-feet (3') long copper-plated steel ground spike, with 1/4-inch diameter copper wire bolted to Flagpole with stainless steel bolt and galvanized steel washer to insulate cable lug from Flagpole.
 2. Base Plate and Wedges: Manufacturer-supplied 3/8-inch thick (minimum) square galvanized steel Plate, three-to-four-inches (3" to 4") larger than Foundation Sleeve Diameter, with self-centering 3/16-inch or 1/4-inch thick centering Wedges, set at top of foundation tube, welded to plate and sleeve, for plumbing Flagpole.
- D. Ornamental Flash Collar: Manufacturer-supplied and fabricated, set at base of Flagpole.
1. Type: Flat profile, manufactured of same material used to match Flagpole.
 2. Size: Minimum diameter of one-inch (1") greater than the diameter of the Ground-Set Foundation Sleeve.
 3. Finish: Match Flagpole finish.
- E. Stainless Steel Revolving Finial Ball/Truck Assembly: Combination of revolving Finial Ball and Truck Assembly, with dual-sealed spindle bearing assembly, manufactured with double thick stainless steel spindle with watertight seams, with removable hood, and Manufacturer-applied gold anodized satin finish.
1. Ten-inch (10") diameter, for use with Internal Halyard System.
- F. Cable-based Internal Halyard Winch System: Internal, manually operated winch, with control stop device and removable handle, 1/8" stainless-steel aircraft-grade cable halyard, non-ferrous sheaves mounted on stainless steel ball bearings, and concealed revolving truck assembly with plastic-coated counterweight and beaded sling assembly. Provide flush access door with continuous piano hinge, secured with compression locking cylinder lock. Finish truck assembly to match Flagpole.
- G. Halyard Flag Snaps: Provide two (2) swivel snap hooks with neoprene or vinyl covers per halyard, as follows: <<<VERIFY>>>
1. Type 304 Stainless steel.
- H. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
1. Acme/Lingo Flagpoles, Southampton, NJ.
 2. Baartol Company, Kenton, OH.
 3. Concord Industries, Inc., Dallas TX.
 4. L.A. Steelcraft, Pasadena, CA.
 5. American Flagpole, Abingdon, VA
 6. Or equal, as approved by the Landscape Architect

2. FLAGS

- A. Contractor shall provide two (2) sets of new Flags to the Owner. (Manufacturer of the Flagpole may stock the Flags as indicated below):
1. United States of America Flag, as manufactured from 2-ply, 100% polyester bunting, with embroidered stars and sewn stripes, brass grommets.
 - a. Size: 5'-0" x 8'-0".
 2. State of California Flag, as manufactured from all-weather perma-nylon, acid-dyed, brass grommets.
 - a. Size: 5'-0" x 8'-0".
 3. City of Torrance Flag, as manufactured from all-weather perma-nylon, acid-dyed, brass grommets. Contractor shall arrange to obtain camera-ready artwork from the Owner or City for custom fabrication of the City of Torrance Flag.
 - a. Size: 5'-0" x 8'-0".
- B. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
1. Tough Tex® US Flags.
 2. Kronbergs Flags, Houston, TX.
 3. or equal, as approved by the Architect.

3. MISCELLANEOUS MATERIALS

- A. Foundation: Provide concrete foundation composed of Portland cement, coarse and fine aggregate, and water mixed in proportions to attain a 28-day compressive strength of not less than 3,000 PSI, complying with ASTM C94. Refer to Section 321323 – Site Concrete.
- B. Reinforcement Bars: Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
- C. Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.
- D. Sand: Meet ASTM C33, fine aggregate.
- E. Elastomeric Sealant: Comply with requirements specified in Section 07 92 00 – Joint Sealants.

3.EXECUTION

1. FABRICATION AND PREPARATION

- A. Prepare in-ground (embed mount) Flagpole by thoroughly shop-coating below-grade pole surfaces (Flagpole sections encased within the Foundation Sleeve) with a heavy coat of bituminous paint inside and out.
- B. Excavation: For foundation, excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete.
- C. Provide forms where required due to unstable soil conditions and for perimeter of Flagpole base at grade. Secure forms and Foundation Sleeve in position, braced to prevent displacement during concrete installation operations.

- D. Concrete foundation and galvanized steel Foundation Sleeve shall be set below the finished surface of surrounding paving, allowing for the depth of paving to meet the base of the Flagpole.
- E. Place concrete immediately after mixing. Compact concrete in place by using vibrators. Moist-cure exposed concrete for not less than seven (7) days or use a non-staining curing compound.
- F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to base perimeter.

2. FLAGPOLE INSTALLATION

- A. General: Install Flagpole in locations as indicated on the Drawings and according to approved Shop Drawings and Manufacturer's written instructions, plumbed and centered in the Foundation Sleeve.
- B. Locate openings for the internal halyard access doors in the same orientation and alignment facing away from the building, as field-directed by the Construction Manager.
- C. Foundation Tube Installation: Install Flagpole in Foundation Sleeve, seated on bottom plate between centering wedges. Install wedges to secure Flagpole plumb in place. Place and compact sand in Foundation Sleeve to firmly secure Flagpole into position; remove wedges. Seal top of Foundation Sleeve with a two-inch (2") layer of elastomeric sealant, and cover with Flashing Collar.
- D. Provide positive lightening ground.
- E. Install Internal Halyard System per Manufacturer's instructions; adjust accordingly to permit smooth non-binding hoisting.
- F. Tolerances: Maximum variation within one-inch (1") of true vertical, measured at the top of the Flagpole, in three (3) directions.

3. PROTECTION AND CLEANING

- A. Protect installed Flagpole assembly against damage throughout the duration of the Contract.
- B. Following installation, inspect Flagpole components. Remove protective packaging and dispose properly. Remove spots, dirt, dust, and debris. Repair damaged finishes to match original finish, or replace component.

4. CLOSEOUT

- A. After erection of Flagpole, install one (1) Flag on each Flagpole, as directed by the Owner.
- B. Deliver the extra set of Flags to the Owner prior to Substantial Completion.
- C. Deliver the Internal Halyard Assembly hand cranks and two (2) sets of keys (clearly identified, for each Flagpole access door) to the Owner prior to Substantial Completion.

END OF SECTION

DIVISION 12

Furnishings

SECTION 129300 – SITE AND STREET FURNISHINGS

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Site and Street Furnishings, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Trash Receptacle (Unit).
 - 2. Bike Rack (Unit).
- C. Related Sections: The following Sections contain requirements of Work that relate to this Section:
 - 1. Section 321313 – Concrete Paving.
 - 2. Section 321323 – Site Concrete (for cast-in-place concrete footings or sub-grade foundations).

2. SUBMITTALS

- A. General:
 - 1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 - 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 - 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
 - 1. Product/Material Data: Submit available product/material literature, test reports, color charts, supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each product/material type in this Section.
 - 2. Shop Drawings to show component parts, fabrication, installation, and dimensions for items indicated herein this Section.
 - 3. Certification: Provide certification from each manufacturer, as specified herein this Section, that their product(s) meet the specific criteria associated for sustainable products.
- C. Material Samples:
 - 1. Submit printed manufacturer's product data, including color charts or color chips of actual fabricated products, for material sample review.

2. Samples of complete Units or parts of Units of the items indicated herein this Section shall be furnished, as requested by Landscape Architect, for review and approval.
 3. Submit manufacturer's written certification that each product complies with specified requirements noted herein.
 - D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
 - E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
3. QUALITY ASSURANCE AND CONTROL
- A. All materials and Work shall be in accordance with the State Codes and Specifications and other criteria herein specified.
 - B. Single-Source Responsibility: Obtain furnishing Units from each respective single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
4. COORDINATION, SCHEDULING, AND OBSERVATIONS
- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
 - B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work. Check adjoining finished surfaces, finished grades, and other Work by accurate field measurements before erection. Maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.
 - C. Perform installation operations only when weather is suitable in accordance with locally accepted practices:
 - D. Coordinating furnishing footings with utility locations. Note potential conflicts to the Landscape Architect.
 - E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.
5. DELIVERY, STORAGE AND HANDLING

- A. Furnishings shall be stored as necessary to prevent damage and shall be in new condition when ready for installation. It shall be the responsibility of the Contractor to install “factory condition” furnishings.
- B. Store materials off ground and under cover, away from damp surfaces and inclement weather.
- C. Deliver manufactured materials in original, unopened packages or containers with manufacturer's labels intact and legible. Deliver and install materials so as to not delay Work, and install only after preparations for installation have been completed.

6. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer’s and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer’s names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. TRASH RECEPTACLE (Unit)

- A. Trash Receptacle Unit shall consist of the complete assembly, consisting of the reinforced pre-cast sealed concrete shell, galvanized steel internal liner, aluminum ash ring, silica sand, and mounting hardware.
 - 1. Manufacturer: Refer to the Contract Drawings.
 - 2. Model Number: Refer to the Contract Drawings.
 - 3. Color/Finish:
 - a. Refer to the Contract Drawings.
 - b. Refer to the Contract Drawings.
- B. Install in quantity as indicated on the Contract Drawings.

2. BIKE RACK (Unit)

- A. Bike Rack Unit shall consist of a complete assembly, including Bike Rack and all applicable mounting hardware.
 - 1. Manufacturer: Refer to the Contract Drawings.

2. Model Number: Refer to the Contract Drawings.
 3. Color/Finishes: Refer to the Contract Drawings.
 4. Mounting and Orientation: Refer to the Contract Drawings.
 - B. Install in quantity as indicated on the Contract Drawings.
3. MISCELLANEOUS MATERIALS
 - A. Anchors, Fasteners, Fittings, and Hardware: Stainless steel, commercial quality, tamper-proof, vandal & theft resistant, concealed, recessed, and capped or plugged. Provide from manufacturer of site furnishing, as applicable.
 - B. Non-shrink, Non-metallic Setting Grout: Pre-mixed, factory-packaged, non-staining, non-corrosive, non-gaseous Setting Grout, suitable for exterior applications, complying with ASTM C1107.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Euco N-S Grout*, Euclid Chemical Co.
 - b. *Crystex*, L&M Construction Chemicals, Inc.
 - c. *Masterflow 713*, BASF Building Systems, Inc.
 - d. *Conspec Enduro 50*, CONSPEC Marketing and Manufacturing Co.
 - e. *Rapidset Grout*, Rapidset Products.
 - f. *SikaGrout 212*, Sika Corporation.
 - g. *Quikcrete Commercial Grade Fast Set Non-Shrink Grout*, Quikcrete Companies.
 - h. *588 Grout*, W.R. Meadows.
 - i. *Certi-Grout #1000*, Vexcon Chemicals.
 - j. Or equal, as approved by the Landscape Architect.
 - C. Erosion-resistant Anchoring Cement: Factory-packaged, non-shrink, non-staining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pour-able 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 of site furnishings, for exterior applications.

3.EXECUTION

1. EXAMINATION
 - A. General: Examine areas and conditions under which site furnishing units are to be installed with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance.
 1. Remedy any conditions detrimental to the proper and timely completion of the Work.
 2. Do not proceed with the Work until unsatisfactory conditions have been corrected in a manner acceptable to the Landscape Architect.
 - B. Verification:
 1. Verify that substrates are stable and capable of supporting the weight of items covered under this Section.
 2. Verify that substrates have been adequately prepared to securely anchor those items that will be surface mounted.

2. INSTALLATION

A. Trash Receptacle (Unit):

1. Trash Receptacle Unit shall be furnished and located as shown on the Contract Drawings, and as directed by the Contract Specifications. Verify exact locations (both at ground level and on-structure) with the Landscape Architect prior to installation.
2. Use actual Unit(s) to establish all dimensions for installation.
3. Erect and install Unit(s) in accordance with the Manufacturer's instructions and recommendations. Install unit(s) plumb, accurately, and in the correct orientation and relationship with other site furnishings, elements and/or paving as shown on the Contract Drawings.
4. Install all anchorage and mounting hardware, as applicable, in strict accordance with Manufacturer's instructions, and as directed by the Landscape Architect.

B. Bike Rack (Unit):

1. Bike Rack Unit shall be furnished and located as shown on the Contract Drawings, and as directed by the Contract Specifications. Verify exact locations and orientation with the Owner's Representative prior to installation.
2. Use actual Unit(s) to establish all dimensions for installation.
3. Erect and install Unit in accordance with the Manufacturer's written instructions and recommendations. Install Unit(s) plumb, accurately, and in the correct orientation and relationship with other site furnishings, elements and/or paving as shown on the Contract Drawings.
4. Install footings, anchorages, or mounting hardware, as applicable, in strict accordance with the Manufacturer's instructions.
 - a. Embed Unit into cast-in-place concrete foundation. Foundation for Unit shall be completely set below work of surrounding pavements.

3. PROTECTION

A. Protect installed furnishings against damage throughout the duration of the construction period, complying with Manufacturer's directions.

1. Remove and replace damaged furnishings as required to deliver factory-condition units at Final Acceptance of Work.

4. CLEANING

A. After completing site furnishing installation, inspect components. Remove protective packaging and dispose properly. Remove spots, dirt, and debris. Repair damaged finishes to match original finish, or replace component.

1. Touch-up Painting: Where directed by the Landscape Architect, clean field welds, bolted connections, and abraded areas of the Work. Paint exposed areas with paint or other material as supplied by the Manufacturer of the damaged Unit. Apply by brush, to thickness recommended by paint manufacturer.

END OF SECTION

DIVISION 22

PLUMBING

SECTION 22 05 00 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Dielectric fittings.
 - 3. Mechanical sleeve seals.
 - 4. Sleeves.
 - 5. Escutcheons.
 - 6. Grout.
 - 7. Plumbing demolition.
 - 8. Equipment installation requirements common to equipment sections.
 - 9. Concrete bases.
 - 10. Supports and anchorages.

1.2 DEFINITIONS

- A. Finished Spaces: Spaces other than plumbing and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and plumbing equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.3 SUBMITTALS

- A. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
- C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series or BAg1, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12.
- G. Solvent Cements for Joining Plastic Piping:
 - 1. ABS Piping: ASTM D 2235.

2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

2.3 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
- F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- B. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe.
- C. Pressure Plates: Stainless steel.
- D. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 - 1. Finish: Polished chrome-plated.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.

1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- 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 otherwise.
- 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. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402, for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
 - 3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 5. PVC Nonpressure Piping: Join according to ASTM D 2855.
 - 6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.

- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.4 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
7. Use 3000-psi (20.7-MPa) 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section Cast-in-Place Concrete.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION

SECTION 22 05 18 - ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Escutcheons.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
 - 1. Escutcheons for New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
- f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
- h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
- j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
- k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons using new materials.

END OF SECTION

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Brass ball valves.
2. Bronze ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze swing check valves.
5. Iron swing check valves.
6. Iron swing check valves with closure control.
7. Bronze gate valves.
8. Iron gate valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Chainwheels.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
- B. NSF Compliance: NSF 61 for valve materials for potable-water service.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
 - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Handlever: For quarter-turn valves NPS 6 and smaller[**except plug valves**].
 - 4. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
 - 1. Gate Valves: With rising stem.
 - 2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
 - 3. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
 - 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 - 2. Solder Joint: With sockets according to ASME B16.18.
 - 3. Threaded: With threads according to ASME B1.20.1.

2.2 BRASS BALL VALVES

- A. One-Piece, Reduced-Port, Brass Ball Valves with Brass Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Kitz Corporation.
 - b. Approved equivalent.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Forged brass.

- e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Brass.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. DynaQuip Controls.
 - d. Flow-Tek, Inc.; a subsidiary of Bray International, Inc.
 - e. Hammond Valve.
 - f. Jamesbury; a subsidiary of Metso Automation.
 - g. Jomar International, LTD.
 - h. Kitz Corporation.
 - i. Legend Valve.
 - j. Marwin Valve; a division of Richards Industries.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Red-White Valve Corporation.
 - n. RuB Inc.
 - o. Approved equivalent.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- C. Two-Piece, Regular-Port, Brass Ball Valves with Brass Trim:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hammond Valve.
 - b. Jamesbury; a subsidiary of Metso Automation.

- c. Legend Valve.
- d. Marwin Valve; a division of Richards Industries.
- e. Milwaukee Valve Company.
- f. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Forged brass.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Brass.
 - i. Ball: Chrome-plated brass.
 - j. Port: Regular.

2.3 BRONZE BALL VALVES

- A. One-Piece, Reduced-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. NIBCO INC.
 - d. Approved equivalent.
 - 2. Description:
 - a. Standard: MSS SP-110.
 - b. CWP Rating: 400 psig (2760 kPa).
 - c. Body Design: One piece.
 - d. Body Material: Bronze.
 - e. Ends: Threaded.
 - f. Seats: PTFE or TFE.
 - g. Stem: Bronze.
 - h. Ball: Chrome-plated brass.
 - i. Port: Reduced.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.

- c. Crane Co.; Crane Valve Group; Crane Valves.
 - d. Hammond Valve.
 - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Approved equivalent.
2. Description:
- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.
 - h. Stem: Bronze.
 - i. Ball: Chrome-plated brass.
 - j. Port: Full.
- C. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. American Valve, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. DynaQuip Controls.
 - f. Hammond Valve.
 - g. Lance Valves; a division of Advanced Thermal Systems, Inc.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Approved equivalent.
2. Description:
- a. Standard: MSS SP-110.
 - b. SWP Rating: 150 psig (1035 kPa).
 - c. CWP Rating: 600 psig (4140 kPa).
 - d. Body Design: Two piece.
 - e. Body Material: Bronze.
 - f. Ends: Threaded.
 - g. Seats: PTFE or TFE.

- h. Stem: Bronze.
- i. Ball: Chrome-plated brass.
- j. Port: Regular.

2.4 IRON, SINGLE-FLANGE BUTTERFLY VALVES

A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.
 - c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - q. Approved equivalent.
2. Description:
 - a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.

B. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Aluminum-Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. Conbraco Industries, Inc.; Apollo Valves.

- c. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - d. Crane Co.; Crane Valve Group; Jenkins Valves.
 - e. Crane Co.; Crane Valve Group; Stockham Division.
 - f. DeZurik Water Controls.
 - g. Flo Fab Inc.
 - h. Hammond Valve.
 - i. Kitz Corporation.
 - j. Legend Valve.
 - k. Milwaukee Valve Company.
 - l. NIBCO INC.
 - m. Norriseal; a Dover Corporation company.
 - n. Red-White Valve Corporation.
 - o. Spence Strainers International; a division of CIRCOR International, Inc.
 - p. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - q. Approved equivalent.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: NBR.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze.
- C. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Ductile-Iron Disc:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - l. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.

- o. Norriseal; a Dover Corporation company.
 - p. Spence Strainers International; a division of CIRCOR International, Inc.
 - q. Sure Flow Equipment Inc.
 - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - s. Approved equivalent.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Nickel-plated[**or -coated**] ductile iron.
- D. 200 CWP, Iron, Single-Flange Butterfly Valves with NBR Seat and Ductile-Iron Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- a. ABZ Valve and Controls; a division of ABZ Manufacturing, Inc.
 - b. American Valve, Inc.
 - c. Conbraco Industries, Inc.; Apollo Valves.
 - d. Cooper Cameron Valves; a division of Cooper Cameron Corporation.
 - e. Crane Co.; Crane Valve Group; Center Line.
 - f. Crane Co.; Crane Valve Group; Stockham Division.
 - g. DeZurik Water Controls.
 - h. Flo Fab Inc.
 - i. Hammond Valve.
 - j. Kitz Corporation.
 - k. Legend Valve.
 - l. Milwaukee Valve Company.
 - m. Mueller Steam Specialty; a division of SPX Corporation.
 - n. NIBCO INC.
 - o. Norriseal; a Dover Corporation company.
 - p. Spence Strainers International; a division of CIRCOR International, Inc.
 - q. Sure Flow Equipment Inc.
 - r. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - s. Approved equivalent.
2. Description:
- a. Standard: MSS SP-67, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.

- d. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
- e. Seat: NBR.
- f. Stem: One- or two-piece stainless steel.
- g. Disc: Nickel-plated[**or -coated**] ductile iron.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - m. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-80, Type 3.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: Bronze.

B. Class 125, Bronze Swing Check Valves with Nonmetallic Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corporation.

- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- j. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-80, Type 4.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Horizontal flow.
 - d. Body Material: ASTM B 62, bronze.
 - e. Ends: Threaded.
 - f. Disc: PTFE or TFE.

2.6 IRON SWING CHECK VALVES

A. Class 125, Iron Swing Check Valves with Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Legend Valve.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Sure Flow Equipment Inc.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
 - n. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.

B. Class 125, Iron Swing Check Valves with Nonmetallic-to-Metal Seats:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.

- b. Crane Co.; Crane Valve Group; Stockham Division.
- c. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Composition.
 - g. Seat Ring: Bronze.
 - h. Disc Holder: Bronze.
 - i. Disc: PTFE or TFE.
 - j. Gasket: Asbestos free.

2.7 IRON SWING CHECK VALVES WITH CLOSURE CONTROL

- A. Class 125, Iron Swing Check Valves with Lever- and Spring-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. NIBCO INC.
 - b. Approved equivalent.
 - 2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and spring.
- B. Class 125, Iron Swing Check Valves with Lever- and Weight-Closure Control:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Milwaukee Valve Company.
 - f. NIBCO INC.
 - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - h. Approved equivalent.

2. Description:
 - a. Standard: MSS SP-71, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Clear or full waterway.
 - d. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - e. Ends: Flanged.
 - f. Trim: Bronze.
 - g. Gasket: Asbestos free.
 - h. Closure Control: Factory-installed, exterior lever and weight.

2.8 BRONZE GATE VALVES

A. Class 125, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Red-White Valve Corporation.
 - k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - l. Zy-Tech Global Industries, Inc.
 - m. Approved equivalent.
2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

B. Class 125, RS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Valve, Inc.

- b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Division.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Milwaukee Valve Company.
 - h. NIBCO INC.
 - i. Powell Valves.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
 - l. Approved equivalent.
2. Description:
- a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: Solid wedge; bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.9 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
 - n. Approved equivalent.
- 2. Description:

- a. Standard: MSS SP-70, Type I.
- b. CWP Rating: 200 psig (1380 kPa).
- c. Body Material: ASTM A 126, gray iron with bolted bonnet.
- d. Ends: Flanged.
- e. Trim: Bronze.
- f. Disc: Solid wedge.
- g. Packing and Gasket: Asbestos free.

B. Class 125, OS&Y, Iron Gate Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Flo Fab Inc.
 - e. Hammond Valve.
 - f. Kitz Corporation.
 - g. Legend Valve.
 - h. Milwaukee Valve Company.
 - i. NIBCO INC.
 - j. Powell Valves.
 - k. Red-White Valve Corporation.
 - l. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - m. Zy-Tech Global Industries, Inc.
 - n. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-70, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Disc: Solid wedge.
 - g. Packing and Gasket: Asbestos free.

2.10 BRONZE GLOBE VALVES

A. Class 125, Bronze Globe Valves with Bronze Disc:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. Hammond Valve.

- d. Kitz Corporation.
- e. Milwaukee Valve Company.
- f. NIBCO INC.
- g. Powell Valves.
- h. Red-White Valve Corporation.
- i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
- j. Zy-Tech Global Industries, Inc.
- k. Approved equivalent.
- 2. Description:
 - a. Standard: MSS SP-80, Type 1.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem and Disc: Bronze.
 - f. Packing: Asbestos free.
 - g. Handwheel: Malleable iron, bronze, or aluminum.
- B. Class 125, Bronze Globe Valves with Nonmetallic Disc:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Crane Co.; Crane Valve Group; Stockham Division.
 - c. NIBCO INC.
 - d. Red-White Valve Corporation.
 - e. Approved equivalent.
 - 2. Description:
 - a. Standard: MSS SP-80, Type 2.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
 - d. Ends: Threaded or solder joint.
 - e. Stem: Bronze.
 - f. Disc: PTFE or TFE.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron, bronze, or aluminum.

2.11 IRON GLOBE VALVES

- A. Class 125, Iron Globe Valves:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.

- b. Crane Co.; Crane Valve Group; Jenkins Valves.
 - c. Crane Co.; Crane Valve Group; Stockham Division.
 - d. Hammond Valve.
 - e. Kitz Corporation.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Powell Valves.
 - i. Red-White Valve Corporation.
 - j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
 - k. Zy-Tech Global Industries, Inc.
 - l. Approved equivalent.
2. Description:
- a. Standard: MSS SP-85, Type I.
 - b. CWP Rating: 200 psig (1380 kPa).
 - c. Body Material: ASTM A 126, gray iron with bolted bonnet.
 - d. Ends: Flanged.
 - e. Trim: Bronze.
 - f. Packing and Gasket: Asbestos free.

2.12 CHAINWHEELS

- A. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
- 1. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
 - 2. Attachment: For connection to butterfly valve stems.
 - 3. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve.
 - 4. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

- E. Install chainwheels on operators for butterfly, gate, and globe valves NPS 4 (DN 100) and larger and more than 96 inches (2400 mm) above floor. Extend chains to 60 inches (1520 mm) above finished floor.

- 1. Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.2 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.

3.3 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball, butterfly[, **or gate**] valves.
 - 2. Throttling Service: Globe, ball, or butterfly valves.
 - 3. Pump-Discharge Check Valves:
 - a. NPS 2 (DN 50) and Smaller: Bronze swing check valves with bronze disc.
 - b. NPS 2-1/2 (DN 65) and Larger for Domestic Water: Iron swing check valves with lever and weight or with spring.
 - 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 SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Select valves, except wafer types, with the following end connections:
 - 1. For Copper Tubing, NPS 2 (DN 50) and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 (DN 125) and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 (DN 50) and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 (DN 125) and Larger: Flanged ends.

3.4 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 PSIG (1035 kPa) OR LESS)

- A. Pipe NPS 2 (DN 50) and Smaller:
 - 1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: One piece, full port, bronze with bronze trim.
 3. Bronze Swing Check Valves: Class 125, bronze disc.
 4. Bronze Gate Valves: Class 125, NRS.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to NPS 100): May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze disc.
 3. Iron Swing Check Valves: Class 125, metal seats.
 4. Iron Gate Valves: Class 125, NRS.
- 3.5 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE (150 TO 200 PSIG (1035 TO 1380 kPa))
- A. Pipe NPS 2 (DN 50) and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Ball Valves: One piece, full port, bronze with bronze trim.
 3. Bronze Swing Check Valves: Class 125, bronze disc.
 4. Bronze Gate Valves: Class 125, NRS.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:
1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to NPS 100): May be provided with threaded ends instead of flanged ends.
 2. Iron, Single-Flange Butterfly Valves: 200 CWP, NBR seat, aluminum-bronze disc.
 3. Iron Swing Check Valves: Class 125, metal seats.
 4. Iron Gate Valves: Class 125, NRS.
- 3.6 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE
- A. Pipe NPS 2 (DN 50) and Smaller:
1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
 2. Bronze Angle Valves: Class 125, bronze disc.
 3. Ball Valves: One piece, full port, bronze with bronze trim.
 4. Bronze Swing Check Valves: Class 125, bronze disc.
 5. Bronze Gate Valves: Class 125, NRS.
 6. Bronze Globe Valves: Class 125, bronze disc.
- B. Pipe NPS 2-1/2 (DN 65) and Larger:

1. Iron Valves, NPS 2-1/2 to NPS 4 (DN 65 to NPS 100): May be provided with threaded ends instead of flanged ends.
2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
3. Iron Swing Check Valves: Class 125, metal seats.
4. Iron Swing Check Valves with Closure Control: Class 125, lever and spring.
5. Iron Gate Valves: Class 125, NRS.
6. Iron Globe Valves: Class 125.

END OF SECTION

SECTION 22 05 29 - 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. Thermal-hanger shield inserts.
 - 4. Fastener systems.
 - 5. Pipe positioning systems.
 - 6. Equipment supports.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- 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.
 - 1. Design supports for multiple pipes 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.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. 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.

- D. Welding certificates.

1.4 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 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 or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 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.
- 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.
- C. Copper Pipe 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.

2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, 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.

2.3 THERMAL-HANGER SHIELD INSERTS

- A. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) minimum compressive strength and vapor barrier.
- B. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig (688-kPa) minimum compressive strength.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, **[zinc-coated]** **[stainless-]** steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, 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 (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. 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 A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- D. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) 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.
- E. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. 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 (DN 65) 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.

- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. 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.
- M. 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. Install MSS SP-58, Type 39, 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 (DN 100) and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40, 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 (DN 100) 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 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
 - 5. Pipes NPS 8 (DN 200) 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 same thickness as piping insulation.

3.2 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.

3.3 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.

3.4 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 (40 mm).

3.5 PAINTING

- A. Touchup: 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.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 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 finish.
- 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 and metal trapeze pipe hangers and attachments for general service applications.
- F. Use stainless-steel pipe hangers 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 (DN 15 to DN 750).
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F (566 deg C), pipes NPS 4 to NPS 24 (DN 100 to DN 600), requiring up to 4 inches (100 mm) of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36 (DN 20 to DN 900), requiring clamp flexibility and up to 4 inches (100 mm) of insulation.
 - 4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8 (DN 15 to DN 200).
 - 5. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30 (DN 15 to DN 750).

6. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 7. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36 (DN 100 to DN 900), with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 8. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30 (DN 25 to DN 750), from two rods if longitudinal movement caused by expansion and contraction might occur.
 9. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 (DN 50 to DN 1050) if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
- 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 (DN 24 to DN 600).
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 (DN 20 to DN 600) 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 up to 6 inches (150 mm) for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450 deg F (49 to 232 deg C) 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. 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 (340 kg).
 - b. Medium (MSS Type 32): 1500 lb (680 kg).

- c. Heavy (MSS Type 33): 3000 lb (1360 kg).
- 8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 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. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches (32 mm).
 - 2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
 - 3. 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.
- P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Use **[powder-actuated fasteners]** [or] **[mechanical-expansion anchors]** instead of building attachments where required in concrete construction.
- R. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Warning signs and labels.
 - 3. Pipe labels.

1.2 SUBMITTAL

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, 0.025-inch (0.64-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
 - 3. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 4. Fasteners: Stainless-steel rivets.
 - 5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.
- C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Yellow.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch (64 by 19 mm).
- F. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel **[rivets] [rivets or self-tapping screws] [self-tapping screws]**.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches (38 mm) high.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting."
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet (15 m) along each run. Reduce intervals to **25 feet (7.6 m)** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 SUMMARY:

- A. This project is required to be Leadership in Energy and Environmental Design (LEED®) NCv4 certified at Gold level. Certain designated credits will be pursued per the requirements of LEED-NC v4.1 and addenda current as of April 2021. See section 018113 "Sustainable Design Requirements" for related product and procedure requirements, references, definitions, documentation requirements, action plans, meetings, and performance requirements of products and systems which relate to the scope of all designers, contractors, and suppliers.
- B. Section includes:
 - 1. Insulation for plumbing piping.
- C. Related requirements:
 - 1. Division 01: General Requirements.
 - 2. Section 220500: Common Work Results for Plumbing.
 - 3. Section 220513: Basic Plumbing Materials and Methods.
 - 4. Section 220553: Plumbing Identification.
 - 5. Section 221000: Plumbing

1.2 REFERENCES:

- A. American Society for Testing and Materials International (ASTM):
 - 1. ASTM C302 - Standard Test Method for Density and Dimensions of Preformed Pipe- Covering-Type Thermal Insulation.
 - 2. ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - 3. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - 4. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
 - 5. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
 - 6. ASTM C1104 - Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - 7. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 8. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. Underwriters Laboratories, Inc.
 - 1. UL 723 - Test for Surface Burning Characteristics of Building Materials.
- C. National Fire Protection Association:
 - 1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

- D. California Code of Regulation Title 24.
 - 1. California Green Building Standards Code.

1.3 SUBMITTALS:

- A. Submit in accordance with Division 01 and Section 220500: Common Work Results for Plumbing.
 - 1. Complete the material list of items to be furnished and installed under this Section.
 - 2. Manufacturer's specifications and other data required to demonstrate compliance with the specified requirements.
 - 3. Shop Drawings, catalog cuts, and manufacturer's data indicating insulation, jacketing, adhesives, and coating. Insulating materials shall be certified by the manufacturer to comply with the California quality standards for insulating materials.
 - 4. Display sample cutaway sections.
 - 5. Manufacturer's recommended method of installation procedures, which will become part of this Section.

1.4 QUALITY ASSURANCE:

- A. Qualifications of Manufacturer and Installer, Materials, Fabrication, Execution, and Standard of Quality: Comply with provisions stated under Section 220500: Common Work Results for Plumbing and Section 220513: Basic Plumbing Materials and Methods.
- B. Insulation Work shall be in accordance with the California Building Energy Efficiency Standards, CBC, Uniform Mechanical Code and the California Green Building Standards Code.
- C. Test Ratings:
 - 1. Comply with provisions stated under Section 22 0500 and 22 0513 with emphasis on ASTM E84, NFPA 255, or UL 723. ASTM C167, ASTM C302, UL label or listing of satisfactory test results from the National Institute of Standards and Technology, or a satisfactory certified test report from an acceptable testing laboratory. Approval by the State Fire Marshal is required.
 - 2. Furnish labels, legibly printed with the name of the manufacturer or listings indicate that fire hazard ratings do not exceed those specified for materials proposed for installation. Flame spread index of not more than 25 and smoke developed rating not exceeding 50.
 - 3. Tests shall be performed on each item individually when insulation, vapor barrier covering, wrapping materials, or adhesives are installed separately at the Project site.
 - 4. Test insulation, vapor barrier covering, wrapping materials and adhesives as an assembly when they are factory composite systems.
- D. Regulatory Requirements: Insulation furnished and installed under this Section shall meet minimum legal requirements of the Building Energy Efficiency Standards adopted and incorporated in the California Energy Commission, Title 24, Part 2, Chapters 2 through 53 and the California Green Building Standards Code unless otherwise noted, for the piping.
- E. Chemically based products such as sealers, primers, fillers, adhesives, etcetera must meet the California air quality regulations.

1.5 PRODUCT HANDLING

- A. Protection, Replacement, Delivery and Storage: Comply with provisions stated under Sections 22 0500: Common Work Results for Plumbing and 22 0513: Basic Plumbing Materials and Methods.

2.1 MATERIALS:

A. General:

1. Insulating material shall be fire resistant, non-corrosive, shall not break, settle, sag, pack or disintegrate under vibration, nor absorb more than 1 percent moisture by weight.
2. Insulating material shall be furnished with thickness indicated in Table 1, and shall furnish thermal resistance in the range of R-4.0 to 4.6 in accordance with inch at 75 degrees F. For any other value of R, insulation thickness shall be calculated accordingly and submitted for review.
3. Asbestos in any quantity in insulating material is not permitted.
4. Provide insulation materials, adhesives, coatings, sealants, fitting covers, and other accessories with a fire hazard rating not to exceed 25 for flame spread, 25 for fuel contributed and 50 for smoke developed, except for materials listed as follows:
 - a. Nylon anchors for installing insulation to equipment.
 - b. Treated wood blocks.
5. Flame-proofing treatments subject to moisture damage are not permitted.
6. TABLE 1 - MINIMUM PIPING INSULATION THICKNESS (1)
7. Insulation Thickness Required (in inches)

Piping System Type	Temp. Range (degrees F)	Runouts up to 2 (2)	1 and less	1.25 to 2	2.5 to 4	5 to 6	8 and larger
Service Water Heating Systems (recirculating, piping supply and return)							
Hot Water	Up to 180	0.5	1.0	1.0	1.5	1.5	1.5
Condensate Drain	½ inch minimum insulation thickness.	0.5	0.5	0.5	0.5	0.5	0.5
From A/C Equipment:	Insulate condensate drain lines within building, in room, inside walls and above ceilings.	0.5	0.5	0.5	0.5	0.5	0.5

8. NOTES: (1) For piping exposed to ambient temperatures, increase thickness by 0.5 inch.

9. (2) Runouts to individual terminal units, not exceeding 12 feet in length.

- B. Lagging Adhesives: Shall be nonflammable and fire-resistant and shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when tested in accordance with ASTM E84. Insulation finished with canvas shall be provided with laps adhered in accordance to manufacturer's recommendation. A finish coat of same material shall be applied to entire outer surface of lagging cloth at coverage specified by

manufacturer.

- C. Canvas Jackets: Provide 6 ounce, in accordance with square foot minimum, 48 by 48 thread count canvas jacketing.
- D. Insulation Jackets:
 - 1. Exterior insulation exposed to weather shall be weatherproofed with Childers aluminum jacketing as basis of design, or Pabco, RPR, or equal. Jacketing shall be manufactured from 1100, 3105 or 5010 aluminum alloy with 3/16 inch corrugations. Smooth or embossed jackets may be permitted in special situations to match an existing installation. Jacketing shall be furnished with an integrally bonded moisture barrier over entire surface in contact with insulation. A minimum thickness of 0.016 aluminum jacketing is to be provided on ducts and piping. A minimum thickness of 0.020 shall be provided on tanks, equipment, and heat exchangers.
 - 2. Insulated elbows, of 90 degrees and 45 degrees, with a nominal iron pipe size of ½inch to 8-inch shall be provided with Childers aluminum Ell-Jacs insulation covers as basis of design, or Pabco, RPR, or equal, manufactured from 1100 aluminum alloy of 0.024 inch thickness. Insulated elbows with a nominal pipe size of 10-inch to 18-inch shall be provided with Childers 4-piece aluminum Ell-Jacs as basis of design, or Pabco, RPR, or equal.
 - 3. Tees, Flanges, and Valve Insulation in Conjunction with Aluminum Jacketing: Furnish Childers Aluminum Special Fabrications Insulation Covers as manufactured by Childers Products Company, Pabco, RPR, or equal.
- E. Adhesives: Adhesives shall be water based, UL Classified, meet the requirements of NFPA 90A and NFPA 90B, have been tested according to relevant ASTM requirements, and be acceptable to the State Fire Marshal. Name, type and method of installation shall be submitted for review.
- F. Valve and Fitting Cover: When installed in conjunction with PVC jacketing, furnish Zeston 25/50 rated polyvinyl chloride fitting covers as manufactured by Johns Manville, Knauf Insulation, Speedline, or equal.

2.2 DOMESTIC HOT WATER PIPING SYSTEM INSULATION:

- A. General: Insulate domestic hot water supply and return piping, including valves, strainers and fittings with insulation thickness as indicated on Table 1.
- B. Materials:
 - 1. Classes of Insulation:
 - a. Class A: Glass fiber molded pipe insulation suitable for service temperatures up to 850 degrees F. Pipe insulation shall be one piece, preformed, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire retardant vapor barrier jacket. Pipe insulation shall be Johns Manville Micro-Lok, Knauf Redi-Klad 1000, Owens Corning FIBERGLAS Pipe Insulation SSL II-ASJ, or equal.
 - b. Class B: Flexible open-cell melamine (foam insulation) suitable for service temperature -150 degrees F to 400 degrees F. Thermal conductivity at 75 degrees F, K= 0.26. Pipe insulation, one-piece pre-formed, laminated to heavy non-reinforced PVC jacket, with locking track, factory installed to jacket, to snap insulation and jacket onto pipe. Similar to TechLite 079 Series as manufactured by Accessible Products Co., or equal. Installation shall comply with manufacturers

recommendations.

- c. Class C: Mineral fiber pipe insulation suitable for service temperatures up to 1200 degrees F. Pipe insulation shall be one-piece, preformed up to 3 inches thick, and provide a minimum R factor of 4.0 at 75 degrees F mean temperature. Insulation shall be faced with all-purpose fire-retardant vapor barrier jacket. Pipe insulation shall be 8 pounds in accordance with cubic foot density by Roxul Techton 1200, Fibrex COREPLUS 1200, Industrial Insulation Group, LLC (IIG) MinWool-1200, or equal.

2. Locations and Class of Insulation Required:

3. TABLE 2 – LOCATIONS AND CLASS OF INSULATION REQUIRED

LOCATION	CLASS OF INSULATION
Equipment Room	A, B or C
Other Locations	A, B or C

4. Fittings on indoor piping shall be covered with flush, hand-wrapped Class A, B, or C insulation, to match the adjoining pipe insulation and covered with polyvinyl chloride fitting covers: Zeston 2000 25/50 by Johns Manville, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal.
5. Adhesive: Fibrous Adhesive to bond calcium silicate to itself and non-porous surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Except as specified herein, install material in accordance with recommendations of manufacturer. Do not install insulation materials until tests specified in other sections are completed. Remove foreign material such as rust, scale, or dirt. Surfaces shall be clean and dry. Maintain insulation clean and dry at all times.
- B. On cold surfaces where a vapor barrier must be provided and maintained, insulation shall be installed with a continuous, unbroken moisture and vapor seal. Hangers, supports, anchors, or other projections that are fastened to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- C. Surface finishes shall be extended in such a manner as to protect raw edges, ends, and surfaces of insulation.
- D. Pipe or duct insulation shall be continuous through walls, ceiling or floor openings, or sleeves; except where firestop or firesafing materials are required.
- E. Metal shields shall be installed between hangers or supports and the piping insulation. Rigid insulation inserts shall be installed between the pipe and the insulation shields. Inserts shall be of equal thickness to adjacent insulation and shall be vapor sealed accordingly.
- F. Insulation shall not be installed in the following locations unless otherwise noted:
1. On unions, flanged connections or valve handles.
 2. Over edges of any manhole, clean-out hole, clean-out plug, and to restrict opening or

identification of access.

3. Over any label or stamp indicating make, approval, rating, inspection, or similar data, unless provision is made for identification and access to label or stamp.

3.2 INSTALLATION OF DOMESTIC HOT WATER PIPING SYSTEM INSULATION

- A. General: Domestic hot water, tempered water supply and return piping and condensate return piping, after having been tested, shall be cleaned and insulated.
- B. Application: Insulate condensate return piping, domestic hot water supply and return, including tempered supply and return piping in accordance with manufacturer's instructions and as specified herein.
 1. Install insulation on valve bodies up to valve bonnet. Fill void in saddles, in accordance with Section 22 0513: Basic Plumbing Materials and Methods, with insulation and seal joints.
 2. Install insulating material to fittings, valves, and strainers and smooth to thickness of adjacent covering. Leave strainer clean-out plugs accessible. Covers fabricated from polyvinyl chloride shall be furnished.
- C. Insulation Jackets in Exposed Indoor Locations:
 1. Cover completed insulation with canvas jacket tightly pasted to covering with lagging adhesive. Lap jacket seams 1 1/2-inch minimum. Finish entire jacket with coating of undiluted adhesive.
 2. Equivalent factory applied pre-sized, glass fiber reinforced, or glass fiber jackets may be furnished. Seal jacket seams with adhesive in accordance with manufacturer's instructions.
 3. Johns Manville Zeston 2000, Knauf Insulation Proto PVC Fitting Cover, Speedline Polyco Smoke Safe, or equal, fitting covers may be furnished, with molded or segmented insulation equal to specified insulation applied to fittings. Secure covers in accordance with manufacturer's instructions.
 4. In addition to above requirements, cover exposed insulated piping within a distance of 8 feet above floors with 26 gage galvanized steel jacket. Omit jacket in areas accessible only to maintenance personnel, such as mechanical equipment rooms, utility corridors, accessible pipe tunnels and manholes.
- D. Concealed Indoor Locations: Cover insulation over fittings, valves, and strainers with canvas. Provide pipe insulation with factory or field applied standard jacket of 4 ounce minimum canvas, fiberglass cloth, or glass fiber reinforced jacket. Seal jacket laps with adhesive in accordance with manufacturer's instructions.
- E. Exposed Outdoors: In addition to canvas or fiberglass cloth cover, pipe insulation exposed to weather shall be provided with an additional 0.016 inches thick aluminum jacket with 2-inch lap connected with one inch hem overlap joint located on side of pipe and turned down to shed water. Jacket shall be strapped 12 inches on center with 1/2-inch wide stainless-steel strapping and wing seals. Aluminum jacket shall be mitered to fit fittings.

3.3 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off the Project site.

3.4 PROTECTION

- A. Protect the Work of this Section until Substantial Completion.

END OF SECTION 220700

SECTION 22 11 16 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Specialty valves.
3. Flexible connectors.
4. Water meters furnished by utility company for installation by Contractor.
5. Water meters.

B. Related Section:

1. Division 22 Section "Facility Water Distribution Piping" for water-service piping[**and water meters**] outside the building from source to the point where water-service piping enters the building.

1.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7.

1.3 SUBMITTALS

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

B. LEED Submittal:

1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.

- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic, potable domestic water piping and components.
- C. Comply with NSF 61 for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. 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.

2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
 - 1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
 - 2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
 - 4. 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.
 - 5. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Elkhart Products Corporation; Industrial Division.
 - 2) NIBCO INC.
 - 3) Viega; Plumbing and Heating Systems.
 - 4) Approved equivalent.
 - b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - c. NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.
 - 6. Copper Push-on-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) NVent LLC.
 - 2) Approved equivalent.
 - b. Description: Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22; with stainless-steel teeth and EPDM-rubber O-ring seal in each end instead of solder-joint ends.
- B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper.
 - 1. Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
 - 2. Copper Pressure-Seal-Joint Fittings:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) Elkhart Products Corporation; Industrial Division.
- 2) NIBCO INC.
- 3) Viega; Plumbing and Heating Systems.
- 4) Approved equivalent.
- b. NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
- c. NPS 3 and NPS 4 (DN 80 and DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 CPVC PIPING

- A. CPVC Tubing System: ASTM D 2846/D 2846M, SDR 11, tube and socket fittings.

2.4 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free, 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- E. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F 493.
 1. Use CPVC solvent cement that has a VOC content of 490 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 2. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.5 SPECIALTY VALVES

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.
- C. CPVC Union Ball Valves:

1. Description:
 - a. Standard: MSS SP-122.
 - b. Pressure Rating: 150 psig (1035 kPa) at[73 deg F (23 deg C).
 - c. Body Material: CPVC.
 - d. Body Design: Union type.
 - e. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket.
 - f. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket.
 - g. Ball: CPVC; full port.
 - h. Seals: PTFE or EPDM-rubber O-rings.
 - i. Handle: Tee shaped.

D. CPVC Ball Check Valves:

1. Description:
 - a. Pressure Rating: 125 psig (860 kPa) at 73 deg F (23 deg C)
 - b. Body Material: CPVC.
 - c. Body Design: Union-type ball check.
 - d. End Connections for Valves NPS 2 (DN 50) and Smaller: Detachable, socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Detachable, socket.
 - f. Ball: CPVC.
 - g. Seals: EPDM- or FKM-rubber O-rings.

E. CPVC Gate Valves:

1. Description:
 - a. Pressure Rating: 125 psig (860 kPa) at[73 deg F (23 deg C).
 - b. Body Material: CPVC.
 - c. Body Design: Nonrising stem.
 - d. End Connections for Valves NPS 2 (DN 50) and Smaller: Socket.
 - e. End Connections for Valves NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Socket.
 - f. Gate and Stem: Plastic.
 - g. Seals: EPDM rubber.
 - h. Handle: Wheel.

2.6 TRANSITION FITTINGS

- A. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- B. Sleeve-Type Transition Coupling: AWWA C219.

- C. Plastic-to-Metal Transition Fittings:
 - 1. Description: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket[**or threaded**] end.
- D. Plastic-to-Metal Transition Unions:
 - 1. Description: CPVC four-part union. Include brass[**or stainless-steel**] threaded end, solvent-cement-joint plastic end, rubber O-ring, and union nut.

2.7 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Dielectric Unions:
 - 1. Description:
 - a. Pressure Rating: 150 psig (1035 kPa).
 - b. End Connections: Solder-joint copper alloy and threaded ferrous.
- C. Dielectric Flanges:
 - 1. Description:
 - a. Factory-fabricated, bolted, companion-flange assembly.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- D. Dielectric-Flange Kits:
 - 1. Description:
 - a. Nonconducting materials for field assembly of companion flanges.
 - b. Pressure Rating: 150 psig (1035 kPa).
 - c. Gasket: Neoprene or phenolic.
 - d. Bolt Sleeves: Phenolic or polyethylene.
 - e. Washers: Phenolic with steel backing washers.
- E. Dielectric Couplings:
 - 1. Description:
 - a. Galvanized-steel coupling.
 - b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
 - c. End Connections: Female threaded.
 - d. Lining: Inert and noncorrosive, thermoplastic.
- F. Dielectric Nipples:
 - 1. Description:

- a. Electroplated steel nipple complying with ASTM F 1545.
- b. Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
- c. End Connections: Male threaded or grooved.
- d. Lining: Inert and noncorrosive, propylene.

2.8 FLEXIBLE CONNECTORS

- A. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

PART 3 - EXECUTION

3.1 EARTHWORK

- A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

- 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 according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- E. Install shutoff valve immediately upstream of each dielectric fitting.
- F. Install domestic water piping level without pitch and plumb.
- G. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- H. Install seismic restraints on piping. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

- I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- J. 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.
- K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- L. Install piping adjacent to equipment and specialties to allow service and maintenance.
- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than 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 piping 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 gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- T. Install thermostats in hot-water circulation piping. Comply with requirements in Division 22 Section "Domestic Water Pumps" for thermostats.
- U. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "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 Division 22 Section "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 Division 22 Section "Escutcheons for Plumbing Piping."

3.3 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 according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.
- G. Copper-Tubing, Push-on Joints: 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. 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 according to ASME B31.9.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
- J. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly or gate valves for piping NPS 2-1/2 (DN 65) and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
 - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
 - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- D. Install balancing valve in each hot-water circulation return branch and discharge side of each pump and circulator. Set balancing valves partly open to restrict but not stop flow. Use ball valves for piping NPS 2 (DN 50) and smaller and butterfly valves for piping NPS 2-1/2 (DN 65) and larger. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves.

3.5 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.

3.6 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

3.7 FLEXIBLE CONNECTOR INSTALLATION

- A. Install bronze-hose flexible connectors in copper domestic water tubing.
- B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.8 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment" for seismic-restraint devices.

- B. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch (10 mm).
- E. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 3/4 (DN 20) and Smaller: 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1 and NPS 1-1/4 (DN 25 and DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- F. Install supports for vertical copper tubing every 10 feet (3 m).
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1-1/4 (DN 32) and Smaller: 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 - 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 - 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 - 5. NPS 3 and NPS 3-1/2 (DN 80 and DN 90): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 - 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 - 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
- H. Install supports for vertical steel piping every 15 feet (4.5 m).
- I. Install vinyl-coated hangers for CPVC piping with the following maximum horizontal spacing and minimum rod diameters:
 - 1. NPS 1 (DN 25) and Smaller: 36 inches (900 mm) with 3/8-inch (10-mm) rod.
 - 2. NPS 1-1/4 to NPS 2 (DN 32 to DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.

- J. Install supports for vertical CPVC piping every 60 inches (1500 mm) for NPS 1 (DN 25) and smaller, and every 72 inches (1800 mm) for NPS 1-1/4 (DN 32) and larger.
- K. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.9 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to 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 required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
 - 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 (DN 65) and larger.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
 - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - 2. 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:

- a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - C. Piping Tests:
 1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
 2. 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.
 3. 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.
 4. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 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 for corrective action required.
 - D. Domestic water piping will be considered defective if it does not pass tests and inspections.
 - E. Prepare test and inspection reports.
- 3.12 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 according to either of the following:

- 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm (50 mg/L) 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 (200 mg/L) of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Prepare and submit reports of purging and disinfecting activities.
- C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

- 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.

3.14 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shutoff Duty: Use ball or gate valves for piping NPS 2 (DN 50) and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 2. Throttling Duty: Use ball or globe valves for piping NPS 2 (DN 50) and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 (DN 65) and larger.
 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.
- D. CPVC valves matching piping materials may be used.

END OF SECTION

SECTION 22 11 19 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following domestic water piping specialties:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated water mixing valves.
 - 6. Strainers.
 - 7. Hose bibbs.
 - 8. Wall hydrants.
 - 9. Drain valves.
 - 10. Water hammer arresters.
 - 11. Trap-seal primer valves.
- B. See Division 22 Section "Domestic Water Piping" for water meters.
- C. See Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.
- D. See Division 22 Section "Domestic Water Filtration Equipment" for water filters in domestic water piping.

1.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig (860 kPa), unless otherwise indicated.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. NSF Compliance:

1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ames Co.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. FEBCO; SPX Valves & Controls.
 - e. Rain Bird Corporation.
 - f. Toro Company (The); Irrigation Div.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Zurn Plumbing Products Group; Wilkins Div.
 - i. Approved equivalent.
3. Standard: ASSE 1001.
4. Size: NPS 1/4 to NPS 3 (DN 8 to DN 80), as required to match connected piping.
5. Body: Bronze.
6. Inlet and Outlet Connections: Threaded.
7. Finish: Rough bronze.

B. Hose-Connection Vacuum Breakers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Arrowhead Brass Products, Inc.
 - b. Cash Acme.
 - c. Conbraco Industries, Inc.
 - d. Legend Valve.

- e. MIFAB, Inc.
 - f. Prier Products, Inc.
 - g. Watts Industries, Inc.; Water Products Div.
 - h. Woodford Manufacturing Company.
 - i. Zurn Plumbing Products Group; Light Commercial Operation.
 - j. Zurn Plumbing Products Group; Wilkins Div.
 - k. Approved equivalent.
- 3. Standard: ASSE 1001.
 - 4. Body: Bronze, nonremovable, with manual drain.
 - 5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
 - 6. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cash Acme.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Honeywell Water Controls.
 - e. Legend Valve.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Plumbing Products Group; Wilkins Div.
 - h. Approved equivalent.
- 3. Standard: ASSE 1012.
- 4. Operation: Continuous-pressure applications.
- 5. Size: NPS 1/2 (DN 15).
- 6. Body: Bronze.
- 7. End Connections: Union, solder joint.
- 8. Finish: Chrome plated.

B. Reduced-Pressure-Principle Backflow Preventers:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

3. Basis-of-Design Product: Subject to compliance with requirements, provide **the** product indicated on Drawings or a comparable product by one of the following:
 - a. Ames Co.
 - b. Conbraco Industries, Inc.
 - c. FEBCO; SPX Valves & Controls.
 - d. Flomatic Corporation.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Zurn Plumbing Products Group; Wilkins Div.
 - g. Approved equivalent.
4. Standard: ASSE 1013.
5. Operation: Continuous-pressure applications.

2.3 BALANCING VALVES

A. Memory-Stop Balancing Valves:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Conbraco Industries, Inc.
 - b. Crane Co.; Crane Valve Group; Crane Valves.
 - c. Crane Co.; Crane Valve Group; Jenkins Valves.
 - d. Crane Co.; Crane Valve Group; Stockham Div.
 - e. Hammond Valve.
 - f. Milwaukee Valve Company.
 - g. NIBCO INC.
 - h. Red-White Valve Corp.
 - i. Approved equivalent.
3. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
4. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
5. Size: NPS 2 (DN 50) or smaller.
6. Body: Copper alloy.
7. Port: Standard or full port.
8. Ball: Chrome-plated brass.
9. Seats and Seals: Replaceable.
10. End Connections: Solder joint or threaded.
11. Handle: Vinyl-covered steel with memory-setting device.

2.4 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 or NPS 3/4 (DN 15 or DN 20) threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig (860 kPa).
7. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Wheel handle.
13. Operation for Finished Rooms: Wheel handle.
14. Include operating key with each operating-key hose bibb.
15. Include[**integral**] wall flange with each chrome- or nickel-plated hose bibb.

2.5 WALL HYDRANTS

A. Nonfreeze Wall Hydrants <Insert drawing designation if any>:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company.
 - b. MIFAB, Inc.
 - c. Prier Products, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Woodford Manufacturing Company.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. Approved equivalent.
3. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig (860 kPa).
5. Operation: Loose key.

6. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
7. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
8. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Box: Deep, flush mounting with cover.
10. Box and Cover Finish: [**Polished nickel bronze**] [**Chrome plated**] <Insert finish>.
11. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
12. Nozzle and Wall-Plate Finish: Polished nickel bronze.
13. Operating Keys(s): One with each wall hydrant.

2.6 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig (2760-kPa) minimum CWP.
3. Size: NPS 3/4 (DN 20).
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL, Inc.
 - b. Josam Company.
 - c. MIFAB, Inc.
 - d. PPP Inc.
 - e. Sioux Chief Manufacturing Company, Inc.
 - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - g. Tyler Pipe; Wade Div.

- h. Watts Drainage Products Inc.
- i. Zurn Plumbing Products Group; Specification Drainage Operation.
- j. Approved equivalent.
- 3. Standard: ASSE 1010 or PDI-WH 201.
- 4. Type: Metal bellows.
- 5. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.8 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. PPP Inc.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Watts Industries, Inc.; Water Products Div.
 - f. Approved equivalent.
- 3. Standard: ASSE 1018.
- 4. Pressure Rating: 125 psig (860 kPa) minimum.
- 5. Body: Bronze.
- 6. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
- 7. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
- 8. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 - 1. Locate backflow preventers in same room as connected equipment or system.
 - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation

of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.
 - C. Install water regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
 - D. Install balancing valves in locations where they can easily be adjusted.
 - E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 1. Install thermometers and water regulators if specified.
 2. Install cabinet-type units recessed in or surface mounted on wall as specified.
 - F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, and pump.
 - G. Install water hammer arresters in water piping according to PDI-WH 201.
 - H. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
 - I. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
 - J. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 1. Intermediate atmospheric-vent backflow preventers.
 2. Reduced-pressure-principle backflow preventers.
 3. Double-check backflow-prevention assemblies.
 4. Water pressure-reducing valves.
 5. Primary, thermostatic, water mixing valves.
 6. Supply-type, trap-seal primer valves.
 - K. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."
- 3.2 FIELD QUALITY CONTROL
- A. Perform the following tests and prepare test reports:
 1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.3 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 22 13 16 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following soil and waste, sanitary drainage and vent piping inside the building:
 - 1. Pipe, tube, and fittings.
 - 2. Special pipe fittings.
- B. See Division 22 Section "Chemical-Waste Systems for Laboratory and Healthcare Facilities" for chemical-waste and vent piping systems.

1.2 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).

1.3 SUBMITTALS

- A. LEED Submittal:
 - 1. Product Data for Credit EQ 4.1: For solvent cements and adhesive primers, including printed statement of VOC content.
- B. Field quality-control inspection and test reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; and "NSF-drain" for plastic drain piping.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Hub-and-Spigot, Cast-Iron Pipe and Fittings: ASTM A 74, Service class.
 - 1. Gaskets: ASTM C 564, rubber.

- B. Hubless Cast-Iron Pipe and Fittings: ASTM A 888 or CISPI 301.
 - 1. Sovent Stack Fittings: ASME B16.45 or ASSE 1043, hubless, cast-iron aerator and deaerator drainage fittings.
 - 2. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
 - a. Standard, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
 - b. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
- C. Solid-Wall PVC Pipe: ASTM D 2665, solid-wall drain, waste, and vent.
 - 1. PVC Socket Fittings: ASTM D 2665, socket type, made to ASTM D 3311, drain, waste, and vent patterns.
 - 2. Solvent Cement and Adhesive Primer:
 - a. Use PVC solvent cement that has a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - b. Use adhesive primer that has a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Special pipe fittings with pressure ratings at least equal to piping pressure ratings may be used in applications below, unless otherwise indicated.
- B. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- C. Aboveground and underground, soil, waste, and vent piping shall be the following:
 - 1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

3.2 PIPING INSTALLATION

- A. Sanitary sewer piping outside the building is specified in Division 22 Section "Facility Sanitary Sewers."
- B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- C. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

- D. 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."
- E. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- F. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- G. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
 - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
 - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
 - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- H. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- I. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Cast-Iron, Soil-Piping Joints: Make joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Gasketed Joints: Make with rubber gasket matching class of pipe and fittings.
 - 2. Hubless Joints: Make with rubber gasket and sleeve or clamp.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.
- D. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.

3.4 VALVE INSTALLATION

- A. General-duty valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves: Install shutoff valve on each sewage pump discharge.
 - 1. Use gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
 - 2. Use gate valve for piping NPS 2-1/2 (DN 65) and larger.
- C. Check Valves: Install swing check valve, downstream from shutoff valve, on each sewage pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to sewage 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. Backwater valves are specified in Division 22 Section "Sanitary Waste Piping Specialties."

3.5 HANGER AND SUPPORT INSTALLATION

- A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
 - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
 - 2. Individual, Straight, Horizontal Piping Runs: According to the following:

- a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet (30 m): MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet (30 m), if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
 2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
 3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8-inch (16-mm) rod.
 4. NPS 6 (DN 150): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.
 5. Spacing for 10-foot (3-m) lengths may be increased to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
- G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
- H. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4 (DN 32): 84 inches (2100 mm) with 3/8-inch (10-mm) rod.
 2. NPS 1-1/2 (DN 40): 108 inches (2700 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2 (DN 50): 10 feet (3 m) with 3/8-inch (10-mm) rod.
 4. NPS 2-1/2 (DN 65): 11 feet (3.4 m) with 1/2-inch (13-mm) rod.
 5. NPS 3 (DN 80): 12 feet (3.7 m) with 1/2-inch (13-mm) rod.
 6. NPS 4 and NPS 5 (DN 100 and DN 125): 12 feet (3.7 m) with 5/8-inch (16-mm) rod.
 7. NPS 6 (DN 150): 12 feet (3.7 m) with 3/4-inch (19-mm) rod.
- I. Install supports for vertical steel piping every 15 feet (4.5 m).
- J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
 1. NPS 1-1/4 (DN 32): 72 inches (1800 mm) with 3/8-inch (10-mm) rod.

2. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 96 inches (2400 mm) with 3/8-inch (10-mm) rod.
 3. NPS 2-1/2 (DN 65): 108 inches (2700 mm) with 1/2-inch (13-mm) rod.
 4. NPS 3 to NPS 5 (DN 80 to DN 125): 10 feet (3 m) with 1/2-inch (13-mm) rod.
 5. NPS 6 (DN 150): 10 feet (3 m) with 5/8-inch (16-mm) rod.
- K. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

- A. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- B. Connect drainage and vent piping to the following:
1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 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 drainage and vent piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 22 Section "Sanitary Waste Piping Specialties."
 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

3.7 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 drainage and vent piping according to procedures of authorities having jurisdiction.

1. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
2. Prepare reports for tests and required corrective action.

3.8 CLEANING

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

END OF SECTION

SECTION 22 13 19 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Roof flashing assemblies.
5. Miscellaneous sanitary drainage piping specialties.
6. Flashing materials.
7. Grease interceptors.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for grease interceptors.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 CLEANOUTS

- A. Exposed Cast-Iron Cleanouts:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.

- e. Watts Drainage Products Inc.
- f. Zurn Plumbing Products Group; Specification Drainage Operation.
- g. Approved equivalent.
- 3. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
- 4. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Floor Cleanouts:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. Oatey.
 - c. Sioux Chief Manufacturing Company, Inc.
 - d. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - e. Tyler Pipe; Wade Div.
 - f. Watts Drainage Products Inc.
 - g. Zurn Plumbing Products Group; Light Commercial Operation.
 - h. Zurn Plumbing Products Group; Specification Drainage Operation.
- 3. Standard: ASME A112.36.2M.
- 4. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts:

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Josam Company; Josam Div.
 - b. MIFAB, Inc.
 - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - d. Tyler Pipe; Wade Div.
 - e. Watts Drainage Products Inc.
 - f. Zurn Plumbing Products Group; Specification Drainage Operation.
- 3. Standard: ASME A112.36.2M. Include wall access.
- 4. Size: Same as connected drainage piping.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Co.
 - b. Josam Company; Josam Div.
 - c. MIFAB, Inc.
 - d. Prier Products, Inc.
 - e. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - f. Tyler Pipe; Wade Div.
 - g. Watts Drainage Products Inc.
 - h. Zurn Plumbing Products Group; Light Commercial Operation.
 - i. Zurn Plumbing Products Group; Specification Drainage Operation.
 - j. **<Insert manufacturer's name.>**

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Floor-Drain, Trap-Seal Primer Fittings **<Insert drawing designation if any>**:

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 (DN 15) side inlet.

B. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4 (DN 100). Use NPS 4 (DN 100) for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet (15 m) for piping NPS 4 (DN 100) and smaller and 100 feet (30 m) for larger piping.
 - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 - 1. Position floor drains for easy access and maintenance.
 - 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 Inches (750 mm) or Less: Equivalent to 1 percent slope, but not less than 1/4-inch (6.35-mm) total depression.
 - b. Radius, 30 to 60 Inches (750 to 1500 mm): Equivalent to 1 percent slope.
 - c. Radius, 60 Inches (1500 mm) or Larger: Equivalent to 1 percent slope, but not greater than 1-inch (25-mm) total depression.
 - 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 - 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- J. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 - 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 - 2. Size: Same as floor drain inlet.
- K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- L. Install vent caps on each vent pipe passing through roof.
- M. Install traps on plumbing specialty drain outlets.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Grease Interceptors: Connect inlet and outlet to unit, and connect flow-control fitting and vent to unit inlet piping. Install valve on outlet of automatic drawoff-type unit.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each grease interceptor.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

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

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Faucets for lavatories.
 - 2. Flushometers.
 - 3. Protective shielding guards.
 - 4. Fixture supports.
 - 5. Water closets.
 - 6. Lavatories.
 - 7. Trap Primers

1.2 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. FRP: Fiberglass-reinforced plastic.
- D. PMMA: Polymethyl methacrylate (acrylic) plastic.
- E. PVC: Polyvinyl chloride plastic.
- F. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" for plumbing fixtures for people with disabilities.
- C. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- F. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
 - 1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
 - 2. Plastic Laundry Trays: ANSI Z124.6.
 - 3. Plastic Shower Enclosures: ANSI Z124.2.
 - 4. Plastic Sinks: ANSI Z124.6.
 - 5. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
 - 6. Slip-Resistant Bathing Surfaces: ASTM F 462.
 - 7. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
 - 8. Stainless-Steel Residential Sinks: ASME A112.19.3.
 - 9. Vitreous-China Fixtures: ASME A112.19.2M.
 - 10. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
 - 11. Water-Closet, Flushometer Tank Trim: ASSE 1037.
- G. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
 - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
 - 2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
 - 3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
 - 4. Faucets: ASME A112.18.1.
 - 5. Hose-Connection Vacuum Breakers: ASSE 1011.
 - 6. Hose-Coupling Threads: ASME B1.20.7.
 - 7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
 - 8. NSF Potable-Water Materials: NSF 61.

9. Pipe Threads: ASME B1.20.1.
 10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
 11. Supply Fittings: ASME A112.18.1.
 12. Brass Waste Fittings: ASME A112.18.2.
- H. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
 2. Brass and Copper Supplies: ASME A112.18.1.
 3. Dishwasher Air-Gap Fittings: ASSE 1021.
 4. Manual-Operation Flushometers: ASSE 1037.
 5. Plastic Tubular Fittings: ASTM F 409.
 6. Brass Waste Fittings: ASME A112.18.2.
 7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.
- I. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Disposers: ASSE 1008 and UL 430.
 2. Dishwasher Air-Gap Fittings: ASSE 1021.
 3. Flexible Water Connectors: ASME A112.18.6.
 4. Grab Bars: ASTM F 446.
 5. Hose-Coupling Threads: ASME B1.20.7.
 6. Hot-Water Dispensers: ASSE 1023 and UL 499.
 7. Off-Floor Fixture Supports: ASME A112.6.1M.
 8. Pipe Threads: ASME B1.20.1.
 9. Plastic Toilet Seats: ANSI Z124.5.
 10. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 - PRODUCTS

2.1 LAVATORY FAUCETS

- A. Lavatory Faucets:
1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Approved equivalent.

2.2 FLUSHOMETERS

A. Flushometers:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Approved equivalent.

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Engineered Brass Co.
 - b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
 - c. McGuire Manufacturing Co., Inc.
 - d. Plumberex Specialty Products Inc.
 - e. TCI Products.
 - f. TRUEBRO, Inc.
 - g. Zurn Plumbing Products Group; Tubular Brass Plumbing Products Operation.
3. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

2.4 FIXTURE SUPPORTS

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

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.

C. Water-Closet Supports:

1. Description: Combination carrier designed for accessible mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Lavatory Supports:

1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.5 WATER CLOSETS

A. Water Closets:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Approved equivalent.

2.6 LAVATORIES

A. Lavatories:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Approved equivalent.

2.7 TRAP PRIMERS

A. Trap Primer Requirements:

1. Installed within a recessed lockable access panel with proper clearances for repair and replacement.
2. Shall be installed with line size unions at each end for ease of replacement.
3. Provide an isolation shutoff valve for repair and replacement.
4. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
 - a. Approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
 - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
 - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
 - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install wall-mounting fixtures with tubular waste piping attached to supports.
- E. Install fixtures level and plumb according to roughing-in drawings.
- F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. Install flushometer valves for accessible water closets with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- J. Install toilet seats on water closets.
- K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

- M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- N. Install traps on fixture outlets.
 - 1. Exception: Omit trap on fixtures with integral traps.
 - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- O. Install escutcheons at piping wall and ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Escutcheons for Plumbing Piping."
- P. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

3.4 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

DIVISION 26

ELECTRICAL

EDIT NOTES:

LAUSD INFORMATION TECHNOLOGY DIVISION IS THE ONLY AUTHORITY FOR CHANGES OR MODIFICATION TO THIS SPECIFICATION. NO CHANGES OR MODIFICATION SHALL BE MADE WITHOUT SPECIFIC WRITTEN AUTHORIZATION OF ITD.

BOLDDED SECTIONS AND TEXT IN BOXES MUST BE REMOVED PRIOR TO ASSEMBLING PROJECT MANUAL.

SECTION 26 01 26 - TEST AND ACCEPTANCE REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

- A. Principal items of work in this section include but are not limited to:
 - 1. Ensure quality assurance, testing and final acceptance requirements for premises cabling installations comply with industry standards and Project Construction Documents.
 - 2. The Los Angeles Unified School District (LAUSD) seeks to improve the quality of its network installations. In order to achieve this objective, the guidelines specified below are to serve as a technical reference for the Owner's infrastructure verification of the Installer's testing. The appendix of this section describes specific test procedures that the Owner shall perform during the acceptance testing, particularly those involving LAN, PABX, VTC, Convergence and WLAN equipment, and associated cable plants. The procedures provide a comprehensive series of visual, electronic, and optical tests to ensure the infrastructure installation complies with the standards set forth in the specifications. The successful culmination of these tests shall be used to document a physical configuration audit (PCA) as part of the Owner's Quality Assurance (Q/A) Report. Testing shall include physical Q/A review of installation and performance testing of components.
- B. Responsibilities for this specification are as follows:
 - 1. Installer: The Installer shall follow CEC, CANSI/EIA/TIA and BICSI installation standards. The Installer shall perform horizontal cable installation including Category 5e and Category 6a unshielded twisted pair (UTP) cable runs terminated in the communications cabinet and cable terminations at each work area outlet, as well as vertical cable installation, including fiber optic cable runs and terminations. During installation the Installer shall perform tests as required by the Parent Specification and in compliance with testing standards found in Appendixes B, C, and D of this Section. The Installer shall notify the Project Inspector 48 hours in advance of any required testing so that the Project Inspector can notify the Owner's Quality Assurance Team to observe the Installer's test procedures. The Installer shall forward test documentation to the OAR prior to the Owner's formal acceptance testing.
 - 2. Contractor's Site Responsibilities during formal Owner's Quality Assurance: During formal Owner's Quality Assurance, the Contractor and his/her Subcontractor shall comply with testing standards and requirements detailed in Appendixes A through F. Under the guidance of the Project Inspector and in coordination with the Owner's Quality Assurance Team, the Installer shall:

- a. Verify LAN connectivity and WAN extension cabling to MDF.
 - b. Configure the router(s) and switch(es) in compliance with the Contract Documents.
 - c. Aid the Owner's Quality Assurance Team with network cut over. (e.g., existing systems with internet connectivity and administration systems including but not limited to SIS and payroll)
 - d. Provide labor, materials, and testing equipment (e.g., Power Meter, OTDR) to correct any deficiencies with labeling, cable charts, terminations, and Installer supplied test results.
 - e. Provide keys and access to installed network equipment.
3. Owner's Quality Assurance Team Responsibilities: Using the procedures specified in the Appendixes of this guideline, the Owner's Quality Assurance Team shall verify that the infrastructure installed under the Contract complies with the installation standards detailed in the Specifications. Specifically, testing shall be performed by the Owner on vertical and horizontal cable (e.g., fiber optic, Category 5e UTP and Category 6a UTP) along with component installations performed under the scope of the overall infrastructure effort (e.g., Ethernet switches and routers). Generally, testing specifications and procedures cover the following:
 - a. Q/A review of equipment rack installation; including placement in the communications cabinets, attachment to the floor, and seismic bracing.
 - b. Q/A review of fiber terminations, patch panel installation, cable labeling, and cable bundling.
 - c. Q/A review of Category 5e and Category 6a, T568B terminations, including cable end connections at the patch panel and work area outlets.
 - d. Q/A review of the Contractor's Redlines for accuracy.
 - e. Industry standard for fiber optic, Category 5e and Category 6a cable performance testing.
 - f. Network equipment performance verification.
 - g. Uninterruptible power supply performance verification.
 - h. Communications cabinet layout and facility drop count verification.
- C. Related Requirements:
 1. Division 01 - General Requirements.
 2. Section 00 7000: General Conditions.
 3. Section 01 7700: Contract Closeout.
 4. Section 06 1000: Rough Carpentry.
 5. Section 26 0500: Common Work Results for Electrical.
 6. Section 26 0513: Basic Electrical Materials and Methods.
 7. Section 26 0526: Grounding and Bonding.
 8. Section 26 0533: Raceways and Boxes Fittings and Supports.
 9. Section 26 2416: Panelboards and Signal Terminal Cabinets.
 10. Section 26 5000: Lighting.
 11. Section 26 5200: Emergency Power Systems.
 12. Section 26 0536: Cable Tray.
 13. Section 27 4113: Closed Circuit TV (CCTV) and Audio Surveillance Systems (New Facilities).
 14. Section 27 4116: Closed Circuit TV (CCTV) and Surveillance Systems (Existing Facilities).
 15. Section 27 1513: Communications Wiring.

16. Section 27 1514: Communications Wiring.
17. Section 27 5115: Public Address and Intercommunication Systems.
18. Section 27 5116: Public Address Systems (Small Gyms, Multipurpose Rooms)(ES).
19. Section 27 5117: Public Address Systems (Auditoriums, Performing Art, M-P Rooms)(MS and HS).
20. Section 27 5118: Public Address Systems (Gymnasiums).
21. Section 27 5119: Public Address Systems (Athletic Fields).
22. Section 27 1515: Television Systems – Coaxial Distribution.
23. Section 27 1516: Television Systems -Fiber Optic Distribution.
24. Section 28 1600: Intrusion Detection Systems.
25. Section 31 2323: Excavation, and fill(Utilities).

D. Acronyms:

dB	Decibel
IDF	Intermediate Distribution Facility
ITD	Information Technology Division
LAN	Local Area Network
LAUSD	Los Angeles Unified School District
LDC	Local Distribution - Classroom
LDF	Local Distribution Facility
MDF	Main Distribution Facility
MPOE	Minimum Point of Entry
NVP	Nominal Velocity of Propagation
OAR	Owner Authorized Representative
PA	Public Address
PBX	Private Branch Exchange
QA	Quality Assurance
UTP	Unshielded Twisted Pair
VoIP	Voice over Internet Protocol
WLAN	Wireless Local Area Network

1.2 SYSTEM REQUIREMENTS

- A. Will be found in Parent Specification.

1.3 SUBMITTALS

- A. Will be found in Parent Specification.

1.4 CODES AND STANDARDS

- A. Telecommunications Industry Association (TIA)/Electronic Industries Association (EIA)-568, Commercial Building Telecommunications Cabling Standard, current issue.

- B. EIA/TIA-569, Commercial Building Standard for Telecommunications Pathways and Spaces.
- C. ANSI/EIA/TIA-598-A, Optical Fiber Cable Color Coding, current issue.
- D. EIA/TIA-606 (2002), Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- E. EIA/TIA-607, Commercial Grounding and Bonding Requirements for Telecommunications.
- F. EIA/TIA-OFSTP-14A, Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant.
- G. ANSI/TIA/EIA-758, Customer-Owned Outside Plant Telecommunications Cabling Standard, current issue.
- H. EIA/TIA-OFSTP-7, Optical Power Loss Measurements of Installed Singlemode Fiber Cable Plant.
- I. American National Standards Institute (ANSI)/EIA/TIA-455-59, Field Testing
- J. FCC Part 68.50.
- K. National Electrical Manufacturer's Association (NEMA).
- L. National Fire Protection Association (NFPA), NFPA-70.
- M. CCR Part 3 - California Electrical Code (CEC).
- N. CCR Part 2 - Uniform Building Code (UBC).
- O. Building Industry Consulting Services International (BICSI) TDMM, most recent revision.
- P. Institute of Electrical and Electronic Engineers (IEEE).
- Q. Other Codes and Standards as defined in the Parent Specification.

1.5 SYSTEM DESCRIPTION

- A. System will be found in Parent Specification.

1.6 QUALITY ASSURANCE

- A. Will be found in Parent Specification.

1.7 WARRANTY

- A. Will be found in Parent Specification.

PART 2 - PROCEDURES

2.1 EQUIPMENT INSTALLATION

- A. The Installer is responsible for basic installation and cross connection of LAN equipment required by the Contract Documents. The Owner's Quality Assurance Team shall verify that basic installation is complete and functional.

2.2 PUNCH LIST

- A. Per OAR request, The Owner's Quality Assurance Team shall assist in the Punch List for IT and low voltage systems and provide it to the OAR.

2.3 CLOSEOUT DOCUMENTATION

- A. Will be found in Parent Specification.

2.4 QUALITY ASSURANCE

- A. Owner's Quality Assurance Test Schedule
 - 1. The Project Inspector shall schedule the Owner's Quality Assurance test after review of the Installers complete Test Results of the school.

PART 3 - EXECUTION AND INSTALLATION

3.1 INSTALLATION

- A. Will be found in Parent Specification.

3.2 OWNER'S QUALITY ASSURANCE CERTIFICATION AND TESTING

- A. Will be found in Parent Specification.

3.3 PROJECT RECORD DOCUMENTS

- A. Will be found in Parent Specification.

3.4 PROTECTION

- A. Will be found in Parent Specification.

3.5 CLEANUP

- A. Will be found in Parent Specification.

3.6 OWNER ORIENTATION

- A. Will be found in Parent Specification.

END OF SECTION

APPENDIX A - QUALITY ASSURANCE PROCEDURES

A.1 Overview of Quality Testing Procedures

This appendix provides guidelines for visual Quality Assurance reviews of each site. The Owner's Quality Assurance Team shall examine the Work based upon the guidelines outlined in the following appendixes and their associated forms.

1. Communications Cabinet Review. Verify the design and compliance with contract documents. This may include: EIA/TIA and BICSI cabling practices, standard and specific labeling practices, and safe and logical equipment and wire management placement.
2. Cable Plant Review. Cabling from the Communications cabinet, at various points along the cable path, and in functional work areas for compliance with TIA/EIA installation specifications including TIA/EIA-568-B and TIA/EIA-569 and documents referenced therein and professional installation practices.
3. User Work Area Quality Assurance Review. Cabling at the user wall plate location in the functional work areas for compliance with TIA/EIA installation specifications including TIA/EIA-568-B and TIA/EIA-569 and documents referenced therein and professional installation practices.
4. Redline As-Built Documentation shall be compared to physical installation. Deviations shall be noted and the Quality Assurance procedure halted until discrepancies have been rectified.

A.2 General Quality Assurance Guidelines

The Owner's Quality Assurance Team visually reviews the installation to verify that cabling is supported properly. Cable trays or structural ties shall support cable. No cable shall have been installed in pathways near sharp edges or objects that might cause damage. Cable shall not be supported by, on, or attached to a dry wall ceiling, ceiling tiles, ceiling grid, routed over pipes, conduit, lighting fixtures, or other wiring. The Owner's Quality Assurance Team should be able to determine the total number of drops dispersed from each communications cabinet, the number of drops for each supported room, and the agreed-upon labeling scheme for the site. The Installer should have met the following general labeling guidelines:

Because work area room numbers may have been modified since the design, the installer shall provide as built documentation for each communications cabinet; reflecting the room numbers used in the labeling scheme as a reference point. The Contractor and his/her Subcontractor shall use these working prints to produce post-installation as-built drawings.

A.3 Deficiency Reports

Before beginning any test, the Owner's Quality Assurance Team shall view any deficiency report(s) (DR) that have been filed with the OAR and Project Inspector. The Owner's

Quality Assurance Team shall review the DR(s) as part of the Quality Assurance review to ensure the required corrective actions have been taken.

A.4 Quality Assurance Test Procedures

The Owner's Quality Assurance Team shall follow the acceptance test and performance criteria outlined in TIA 568B, OFSTP-14A, OFSTP-7 and shall conduct acceptance and performance testing following each manufacturer's specification on their respective network components to verify compliance with manufacturer's installation instructions.

The Owner's Quality Assurance Team shall also follow any specific local policy directives or instructions regarding installation practices and/or acceptance testing identified during the site orientation visit. The details for the design of a particular location shall also comply with any related State, County and Municipal standards.

A.5 Construction Quality Assurance of Work:

During the installation of low voltage systems, upon request by the OAR, the Owner's Quality Assurance Team shall examine the following:

1. General to Low Voltage Systems:
 - a. Conduit and raceway layout and installation for each low voltage system and verify that they meet project specifications.
 - b. Equipment rack installation, including placement in the communications room, seismic bracing, and attachment to the floor.
 - c. Cable punch-downs, patch panel installation, cable cross-connection, cable labeling, and cable bundling.
 - d. Verify proper equipment installation, cable cross connection, system configuration, and testing.
 - e. Verify system layout and device location(s) match the locations shown on the as-builds.
 - f. Active components, terminal cabinets, cross connects, splices, etc. are located in a secure interior location.
 - g. Verification of Uninterruptible power supply performance.
 - h. Verification of proper air conditioning in MDF and IDFs. Room temperature should maintain between 65 - 72 degrees 7 days per week, 24 hours per day.
 - i. Terminations punched down singly and cross-connected on 66 blocks. 66 blocks are primarily used in Public Address systems and Intercom. PBX cable plants are specified to use 110-blocks exclusively.
2. LAN, verify the following:
 - a. Examine Category 5e and Category 6a, T568B terminations, including cable end connections at the patch panel and wall drop receptacles.
 - b. Examine fiber terminations and fiber termination boxes.
 - c. Examine Installer's basic network components installation and operation.
 - d. Review customized configuration and test results.
 - e. Test overall network operation to ensure it meets Owner's strategic planning and acceptable performance level.

A.6 Start Up

Start-up work is to be completed as a condition for Substantial Completion. Start-Up is to include the testing and commissioning of equipment and systems.

1. After start up has been completed but prior to Substantial Completion, the Project Inspector shall schedule the Owner's Quality Assurance Team site visit.
2. The Owner's Quality Assurance Team shall review documentation and test results for completeness.
3. The Owner's Quality Assurance Team shall visit the site and verify the Contractor's test results by the Quality Assurance procedures detailed herein.

A.7 Contract Completion and Process Review

The Quality Assurance Team shall review the entire Quality Assurance process and recommend changes to improve it on an as needed basis.

A.8 Test Procedures

1. Visual Q/A Reviews
 - a. The Owner's Quality Assurance Team shall conduct a visual review of the installation including the communication cabinet, cable runs, and user work areas. Appendix A documents these Q/A review procedures.
2. Cable Performance Testing
 - a. The Owner's Quality Assurance Team shall test 100% of the fiber optic Backbone cable, a random sample of Category 5e and Category 6a UTP cable and the fiber optic Horizontal cable. Appendix C outlines these specific tests.
 - (1) Test Cable Sampling: The Owner's Quality Assurance Team shall randomly test 10% of installed horizontal cables from each communication cabinet on site. For example, if a communications cabinet has 100 drops, the Owner's Quality Assurance Team shall test a minimum of 10 drops for each cabinet. Where random testing shows a failure rate of more than 1% of the drops (2 in 10 of the random sample), an additional 10% of the installed horizontal cabling shall be tested. Appendix B outlines these specific tests.
 - (2) Cable Testing: The Owner's Quality Assurance Team shall perform the following industry-standard operational and performance cable testing detailed in TIA/EIA 568B.1:
 - (a) Wire map
 - (b) Length verification
 - (c) Insertion loss (attenuation)
 - (d) Near-end crosstalk (NEXT)
 - (e) Power sum near-end crosstalk (PSNEXT)
 - (f) Equal level far-end crosstalk (ELFEXT)
 - (g) Power sum equal level far-end crosstalk (PSELFEXT)
 - (h) Return loss
 - (i) Propagation delay
 - (j) Delay skew
3. Network Equipment Testing
 - a. The Owner's Quality Assurance Team shall perform network tests on hardware components for proper installation, per manufacturer's recommendations and configuration. Components shall be tested separately for initial power up and

their ability to maintain system configuration. The specific test for network equipment components is described in Appendix D.

A.9 Acceptance Criteria

1. An overall Pass or Fail condition shall be determined by the results of the required individual test. Any Fail and Fail* shall result in an overall Fail. In order to achieve an overall Pass condition, individual results shall be Pass or Pass*. A Pass or Fail result for each parameter is determined by the allowable limits for that parameter. The test result of a parameter is marked with an asterisk (*) when the result is closer to the test limit than the accuracy of the field tester. The field tester manufacturer shall provide documentation as an aid to interpret results marked with asterisks.
2. Cable plant acceptance by the Owner requires 100% passing results for cable samples and corrected cabling deficiencies. Acceptance of other components is based upon satisfactory completion of a test configuration scenario, as defined in the appropriate appendix to this plan.

A.10 Corrective Procedures

1. EIA/TIA testing specification details a pass/fail criterion, i.e., if a fiber optic cable is outside of specifications, the test fails, The Owner's Quality Assurance Team shall identify any deficiencies found during Quality Assurance (e.g., a cable or component failing a test) to site personnel before the Owner's Quality Assurance Teams departure and shall document these deficiencies in the Quality Assurance Report. If the link attenuation for any fiber optic cable strand is outside acceptable loss as specified in TIA/EIA-568-B, the Installer shall re-complete the terminations required to reduce the amount of attenuation. If re-termination fails, the Installer shall be required to take steps up to and including the replacement of the cable to eliminate the testing deficiency. After corrective action, the Owner's Quality Assurance Team shall retest repaired fiber runs and document the results in the Quality Assurance Report.
2. The Owner's Quality Assurance Team shall identify to the Owner in writing any deviation from acceptable EIA/TIA specifications for cabling resulting in a test failure. The Owner may choose to accept the deficiency via a written waiver. For example, if a fiber optic connection exceeds the allowable termination attenuation by 0.1 decibels (dB), but the total link attenuation is within the length attenuation budget, the Owner may choose to waive the specification. Other components (e.g., switches or routers) must function according to the specified configurations in the final Work Plan for Owner LAN projects.

A.11 Quality Assurance Reporting

1. Acceptance Recommendation
 - a. At the conclusion of testing, the Owner's Quality Assurance Team shall provide a recommendation to Owner to accept or not accept the installation.
2. Quality Assurance Report
 - a. The Owner's Quality Assurance Team shall deliver a Quality Assurance Report to the project OAR no later than seven (7) working days after completion of testing. This report shall include:
 - (1) A written test report for visual installation tests.

- (2) Electronic test results of cable testing including verified cable lengths, test personnel, test date, and individual test description.
- (3) Each detected deficiency with its correction date and retest results, if accomplished.
- (4) Network operational test results for the switch(s) and router connections.
- (5) Any condition(s) precluding strict adherence to NEC, EIA/TIA, and BICSI installations or Quality Assurance standards shall be marked for potential Owner waiver before system acceptance.
- (6) A summary confirming the acceptance recommendation given.

A.12 Test Equipment

- 1. The Owner's Quality Assurance Team shall use the following test equipment or their equivalent during testing.
 - a. Fluke DSP 4300 Level III, or equal, tester with single-mode and multi-mode power meter and light source heads.
 - b. Fluke Optifiber Optical Time Domain Reflectometer (OTDR)
 - c. Personal computer with Transmission Control Protocol/Internet Protocol (TCP/IP) protocol stacks.
 - d. Thermometer

Table 2.6.1 T & A Checklist for Owner's Quality Assurance Team Projects

Site Location Code / Name _____ OAR _____

Network Engineer _____ Insp
ector _____

OAR Recommendation _____ Electrical
Inspector _____

Review Item	Yes	No	N/A	Pass/Fail
Have deficiencies been cleared by the Project Inspector or OAR?				
Has the vendor provided cable charts in the cabinets?				
Are there any horizontal cables over 90m?				
Do the cable runs used agree with the cable routing drawings?				
Are the cables routed and terminated per specification?				
Are cable run penetrations terminated to preclude strain on the installed cable?				
Are the copper and fiber optic cables installed per the manufacturer's recommendation?				
Is each cable clearly labeled at the user's location?				
Is each port on the patch panel labeled with the corresponding user outlet location?				
Are cable and patch panel labels securely fastened and easily readable?				
Are the fiber cables in the fiber termination box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?				
Is the cable for each drop identified with the correct labeling scheme at or near the point of termination?				
Does the user outlet plate display the correct labeling scheme and match the distant end label?				
Are connectors free of exposed metal, loose connectors, or other problems?				
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?				
Is the physical plant installed in accordance with specifications of this project?				
For traditional, hierarchical star cable plants following 25568 specifications, are there at least 50% spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF ?				

For new fiber optics cable plant installations following 25569 specifications, are there at least 15 percent spare Backbone strands, in multiples of 6 strands, to each IDF from the MDF ?				
Does this site have an existing Local Area Network?				
Is the T1 line correctly installed and ready to cut over? Also, has the extension to the MDF been installed?				
Will the site reutilize an existing router? If yes, specify exact model / serial number.				
Is the router configured and ready for cut over?				
Are the required amounts of GB Uplinks provided to accommodate the equipment installed including port expansion?				
Are classroom and administration switches mounted, connected, and operational?				
Has the vendor provided inventory and the drop count been verified or has an Inventory document been completed? If so, please attach.				

A.13 Visual Q/A Review Worksheets

The following pages provide the three visual Quality Assurance worksheets:

1. Communications Cabinet Quality Assurance Review Form
2. Cable Routing Quality Assurance Review Form
3. User Work Area Quality Assurance Review Form

A.13.1 Communications Enclosure Quality Assurance Review Form

Site _____ Date _____ Quality Assurance Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Is the cabinet ready for a Q/A review? If not, list discrepancies (e.g., debris, punch- list, or un-terminated cable).		
Is the installation performed in the planned communications cabinet?		
Are there clearly identified final or redlined drawings showing the "as-built" installation?		
With all devices operating, are ambient cabinet and room temperatures within 50-80° F? The temperature is: ____.		
Are heating, ventilation, and air conditioning (HVAC), lighting, and electrical outlets installed per contract? Are the requirements addressed in the Site Concurrence Memorandum or other documentation?		
Are cabinet rails and wire managers installed so as to preclude any space problems with the UPS?		
Are the cabinets seismically braced to the floor and/or wall?		
Is there adequate space around the racks and fiber termination panel for maintenance?		
Are patch panels, wire management panels, and network equipment properly affixed to the rack?		
Is debris cleaned from inside of cabinets?		
Are cable run penetrations installed so fire barriers are maintained in cabinet locations?		
Are cable run penetrations properly and securely fastened to supporting structures?		
Are cable run penetrations terminated to preclude strain on the installed cable in cabinet locations?		
Are cables routed and punched per specification and industry standards?		
Is each cable clearly labeled with the corresponding user location per specification?		
Is each port on the patch panel labeled with the corresponding user location per specification?		
Are cable and patch panel labels securely fastened and easily readable per specification?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the UTP cable jacket stripped back only as far as required to terminate on connecting hardware?		

Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the fiber optic cable free from excessive strain or stress, sharp bends, or kinks?		
Are service loops in place at each end of the cable?		
Are the fiber cables in the fiber termination unit? Is the box labeled per the approved labeling scheme and immediately adjacent to each termination within the fiber termination box?		
Is excess fiber optic cable coiled in the termination box so it does not exceed the minimum bend radius per manufacturer's recommendations and specifications?		
Are fiber optic patch cords neatly routed to the network equipment via wire management?		

A.13.2 Cable Routing Q/A Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are cable bundles either secured to the wall or to a non-electromagnetic interference-producing source or hung from the ceiling (e.g., suspended via cable trays, inner duct, J-hooks, D-rings, or ladder rack) per specification or best industry standards?		
Do the cable runs used agree with the redline drawings?		
If not, are accurate redlined drawings available showing the cable routing?		
Is debris from the cable run penetrations adequately cleaned up per specification?		
Is the fiber optic cable runs completely contained within inner duct? Where?		

Notes:		
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A.13.3 User Work Area Q/A Review Form

Site _____ Date _____ Q/A Rep(s) _____

Q/A REVIEW ITEM	PASS	FAIL
Are wall jack faceplates professionally installed and finished?		
Is cabling precluded from view on the external surface of walls (e.g., ducting used on solid core walls)?		
Does the user outlet plate display the correct labeling scheme?		
Is the cable for each drop identified with the correct labeling scheme and within 2 inches of termination per specification?		
Is the cable installed in a manner that precludes cable strain?		
Are connectors insulated from surrounding cable and objects (e.g., are cable barrel adapters, connectors, devices, and terminators insulated from any earth ground or current-conducting surfaces of the building structure)?		
Are connectors free of exposed metal, loose connectors, or other problems?		
Is there ½-inch or less of untwisting on any cable pair at the termination point?		
Is the cable jacket stripped back only as far as required to terminate on connecting hardware?		
Is a bend radius of at least 1-inch maintained for sheathed UTP cable?		
Is the 4 or 6 strand fiber secured properly in the LDFs and LDCs?		
Notes:		

APPENDIX B - CATEGORY 5E AND CATEGORY 6 UTP CABLE PERFORMANCE TESTS

B.1 Overview of Cable Tests

This appendix provides guidelines for electronic testing of Horizontal Category 5e UTP wiring. The Owner's Quality Assurance Team shall meet the guidelines outlined in the following Q/A review and its associated forms.

1. Electronic Testing. This testing verifies that the standard performance parameters for the UTP cable as outlined in TIA/EIA 568-B are within the specifications as noted below. TIA/EIA 568-B addresses specific field-tests for post-installation performance measurements of the designed cable plants. Owner only uses Category 5e, or Category 6a UTP cables for its LAN installations. Refer to Premise Wiring Specification.

B.2 Test and Support Equipment

1. The types of cable to be tested are as follows :
 - a. Category 5E UTP shall be tested based on TIA/EIA 568-B.1 section 11.2.3 specifications
 - b. Category 6a UTP shall be tested based on TIA/EIA 568-B.2-1

Note: Sections B2 through B6 address Category 5E related tests, requirements, and specifications. Sections B7 through B11 address Category 6a related tests, requirements, and specifications.

B.3 Electronic Tests

The Owner's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The **permanent** link test configurations described in TIA/EIA 568-B.1 section 11.2.4.1, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 W 4-pair Category 5e cabling. 568-B.1 section 11.2.4.3 thru .11 identifies acceptable ranges of test results, test equipment checks, diagnostic information, and specific test procedures.

TIA/EIA 568-B.1 section 11.2.4.1, also specifies laboratory measurement methods, component and field test methods and computation algorithms over the specified frequency range. To ensure verifiable equipment calibration, the Owner's Quality Assurance Team shall certify test

equipment accuracy in compliance with 568-B.1 section 11.2.4.3 thru .10 each time a new list of tests is performed.

The Owner's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet TIA/EIA-568-B Category 5e specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.4 Data Accuracy

Tests shall be conducted on the premise that TIA/EIA-568-B and other applicable specifications were applied to the cable installation. Further, the Owner's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction.

B.5 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-B), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.6 Communications Wiring Electrical Tests

B.6.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.6.2 Length

The field tester shall be capable of measuring length of all pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation (1). The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

B.6.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term "Attenuation" has been used to designate "Insertion Loss." Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest

attenuation value measured (worst case), the frequency at which this worst case value occurs, and the test limit value at this frequency.

B.6.4 NEXT Loss

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 1

Frequency (MHZ)	Range	Maximum Step Size (MHz)
1 – 31.25		0.15
31.26 – 100		0.25
100 – 250		0.50

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.5 PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of 8 results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.6 ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire

pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 1, column 2. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 1, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.6.10 Delay Skew

This parameter shows the difference in propagation delay between the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.6.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.6.12 PSACR

B.7 Communications Wiring Electrical Test Form

Site _____ Date _____ Q/A Rep(s) _____
Building and Communications Room Numbers _____

MICROTEST SAVE ID	CABLE TESTED ROOM/DROP #	PASS/ FAIL	COMMENTS - IF FAILED (Wire Map, Length, Attenuation, Continuity, or NEXT Tests)

B.8 Electronic Tests

The Owner's Quality Assurance Team randomly selects cables for testing and every effort shall be made to avoid a typical testing pattern from communications cabinet to work area outlet, so that no testing pattern is discernible. The testing personnel shall inspect drops on the faceplate in multiple cases to ensure cables are labeled and no cross connects are visible, etc. The testing personnel shall perform a Q/A review of the cable termination(s) in the Communications cabinet(s) and the corresponding user location of selected cables (e.g., the faceplate labels or terminations behind the termination panel). The personnel must be consistent in testing selected cables.

The **permanent** link test configurations described in TIA/EIA 568-B.2-1, performance parameters include wire map, length, Insertion loss (attenuation), NEXT, PSNEXT, ELFEXT, PSELFEXT, Return loss, Propagation delay and Delay Skew for 100 W 4-pair Category 6a cabling. 568-B.2 identifies acceptable ranges of test results, test equipment checks, diagnostic information and specific test procedures as related to Category 6a cabling. TIA/EIA 568-B.2-1 also includes laboratory measurement methods, component and field test methods, and computation algorithms over the specified frequency range. The test equipment (tester) shall comply with the accuracy requirements for level III field testers as defined in TIA/EIA 568-B.2-1. The tester including the appropriate interface adapter must meet the specified accuracy requirements. The accuracy requirements for the permanent link test configuration (baseline accuracy *plus* adapter contribution) are specified in Table B.2 of Annex B of e TIA/EIA 568-B.2-1 standard. (Table B.3 in this TIA document specifies the accuracy requirements for the Channel configuration.)

The Owner's Quality Assurance Team shall consider cable(s) and cabling components as pre-tested by the manufacturer to meet TIA/EIA-568-B.2-1 Category 6a specifications. Therefore, individual testing of connectors and other cabling components is not required.

B.9 Data Accuracy

Tests shall be conducted on the premise that TIA/EIA-568-B.2 and other applicable specifications were applied to the cable installation. Further, the Owner's Quality Assurance Team shall be provided the test result book to verify the Installer tested 100 percent of their work, so the sampling tests performed ensures system operability and customer satisfaction. The tester interface adapters must be of high quality and the cable shall not show any twisting or kinking resulting from coiling and storing of the tester interface adapters. In order to deliver optimum accuracy, preference is given to a permanent link interface adapter for the tester that can be calibrated to extend the reference plane of the Return Loss measurement to the permanent link interface. The contractor shall provide proof that the interface has been calibrated within the period recommended by the vendor. To ensure that normal handling on the job does not cause measurable Return Loss change, the adapter cord cable shall not be of twisted-pair construction.

B.10 Data and Test Reporting

The Quality Assurance Report shall clearly identify the test environment, test equipment used, name of each tester, acceptable results (as specified in 568-B Category 6a related), and actual results for each test performed. If a failure occurs, the test shall proceed, with the failure reported to the responsible Installer for repair at test end.

B.11 Communications Wiring Electrical Tests

The test parameters for Category 5e and Category 6a are defined in TIA/EIA-568-B.2 standard. The test of each link shall contain of the following parameters as detailed below. In order to pass the test, measurements (at each frequency in the range from 1 MHz through 350 MHz) must meet or exceed the limit value determined in the above-mentioned standard.

B.11.1 Wire Map

Wire Map shall report Pass if the wiring of each wire-pair from end to end is determined to be correct. The Wire Map results shall include the continuity of the shield connection if present.

B.11.2 Length

The field tester shall be capable of measuring length of pairs of a permanent link or channel based on the propagation delay measurement and the average value for Nominal Velocity of Propagation. The physical length of the link shall be calculated using the pair with the shortest electrical delay.

This length figure shall be reported and shall be used for making the Pass/Fail decision. The Pass/Fail criteria are based on the maximum length allowed for the Permanent Link configuration (90 meters – 295 feet) plus 10% to allow for the variation and uncertainty of NVP.

B.11.3 Insertion Loss (Attenuation)

Insertion Loss is a measure of signal loss in the permanent link or channel. The term “Attenuation” has been used to designate “Insertion Loss.” Insertion Loss shall be tested from 1 MHz, through the highest applicable frequency. It is preferred to measure insertion loss at the same frequency intervals as NEXT Loss in order to provide a more accurate calculation of the Attenuation-to-Crosstalk ratio (ACR) parameter.

Minimum test result documentation (summary results): Identify the worst wire pair (1 of 4 possible). The test results for the worst wire pair must show the highest attenuation value measured (worst case), the frequency at which this worst case value occurs and the test limit value at this frequency.

B.11.4 NEXT Loss

Pair-to-pair near-end crosstalk loss (abbreviated as NEXT Loss) shall be tested for each wire pair combination from each end of the link (a total of 12 pair combinations). This parameter is to be measured from 1 through the highest applicable frequency. NEXT Loss measures the crosstalk disturbance on a wire pair at the end from which the disturbance signal is transmitted (near-end) on the disturbing pair. The maximum step size for NEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test results documentation (summary results): Identify the wire pair combination that exhibits the worst case NEXT margin (2) and the wire pair combination that exhibits the worst value of NEXT (worst case).

Table 2

Frequency Range (MHZ)	Maximum Step Size (MHz)
1 – 31.25	0.15
31.26 – 100	0.25
100 – 250	0.50
250-350	1.00

NEXT is to be measured from each end of the link-under-test. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.5

PSNEXT Loss

Power Sum NEXT Loss shall be evaluated and reported for each wire pair from both ends of the link-under-test (a total of eight results). PSNEXT Loss captures the combined near-end crosstalk effect (statistical) on a wire pair when other pairs actively transmit signals. Like NEXT this test parameter must be evaluated from 1 MHz through the highest applicable frequency and the step size may not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSNEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.6

ELFEXT Loss, pair-to-pair

Pair-to-pair FEXT Loss shall be measured for each wire-pair combination from both ends of the link under test. FEXT Loss measures the crosstalk disturbance on a wire pair at the opposite end (far-end) from which the transmitter emits the disturbing signal on the disturbing pair. FEXT is measured to compute ELFEXT Loss that must be evaluated and reported in the test results. ELFEXT measures the relative strength of the far-end crosstalk disturbance relative to the attenuated signal that arrives at the end of the link. This test yields 24 wire pair combinations. ELFEXT is to be measured from 1 through the highest applicable frequency and the maximum step size for FEXT Loss measurements shall not exceed the maximum step size defined in the draft standard as in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ELFEXT. These wire pairs must be identified for

the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.7 PSELFEXT Loss

Power Sum ELFEXT is a calculated parameter that combines the effect of the FEXT disturbance from three wire pairs on the fourth one. This test yields 8 wire-pair combinations.

Each wire-pair is evaluated from 1 MHz through the highest applicable frequency in frequency increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSELFEXT. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.8 Return Loss

Return Loss (RL) measures the total energy reflected on each wire pair. Return Loss is to be measured from both ends of the link-under-test for each wire pair. This parameter is also to be measured from 1 through the highest applicable frequency in increments that do not exceed the maximum step size defined in the draft standard as shown in Table 2, column 2.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for Return Loss. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.9 Propagation Delay

Propagation delay is the time required for the signal to travel from one end of the link to the other.

This measurement is to be performed for each of the four wire pairs.

Minimum test result documentation (summary results): Identify the wire pair with the worst case propagation delay. The report shall include the propagation delay value measured as well as the test limit value.

B.11.10 Delay Skew

As defined in TIA/EIA-568-B.1; Section 11.2.4.11, this parameter shows the difference in propagation delay between the four wire pairs. The pair with the shortest propagation delay is the reference pair with a delay skew value of zero.

Minimum test result documentation (summary results): Identify the wire pairs with the worst-case propagation Delay skew. The report shall include the Delay skew value measured as well as the test limit value.

B.11.11 ACR (Attenuation to crosstalk ratio)

This parameter is not required by TIA standards but may be expected in order to obtain the premise wiring manufacturer's warranty.

ACR provides an indication of bandwidth for the two wire-pair network applications. ACR is a computed parameter that is analogous to ELFEXT and expresses the signal to noise ratio for a two wire-pair system. This calculation yields 12 combinations – six from each end of the link. Minimum test result documentation (summary results): Identify the wire pair combination that exhibits the worst-case margin and the wire pair combination that exhibits the worst value for ACR. These wire pair combinations must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.11.12 PSACR

This parameter is not required by TIA standards but may be required in order to obtain the premise wiring vendor's warranty. The Power Sum version of ACR is based on PSNEXT and takes into account the combined NEXT disturbance of adjacent wire pairs on each individual pair. This calculation yields 8 combinations – one for each wire pair from both ends of the link.

Minimum test result documentation (summary results): Identify the wire pair that exhibits the worst case margin and the wire pair that exhibits the worst value for PSACR. These wire pairs must be identified for the tests performed from each end. Each reported case shall include the frequency at which it occurs as well as the test limit value at this frequency.

B.12 Communications Wiring Electrical Test Form

Site _____ Date _____ Q/A Rep(s) _____

Building and Communications Room Numbers _____

MICROTEST SAVE ID	CABLE TESTED ROOM/DROP #	PASS/ FAIL	COMMENTS - IF FAILED (Wire Map, Length, Attenuation, Continuity, or NEXT Tests)

APPENDIX C - FIBER OPTIC CABLE PERFORMANCE TESTS

C.1 Overview of Cable Tests

TIA/EIA-568-B.3 states, "The optical fiber cable construction shall consist of 50/125 μm or 62.5/125 μm multimode optical fibers or single mode optical fibers, or a combination of these media." Multimode fiber shall have a graded-index optical fiber waveguide with nominal 50/125 μm for installations following specification 27 1514, or 62.5/125 μm core/ cladding diameter for installations following specification 27 1513. Primary and secondary backbone cable testing shall be equivalent to backbone cabling as defined in TIA/EIA-568-B.1 section 11.3.3, such as cabling interconnecting telecommunications closets, equipment cabinets, and entrance facilities. Therefore, the Owner's Quality Assurance Team shall perform the following interrelated tests:

1. Verification of multi-mode fiber optic cable installations.
2. Verification of single-mode fiber optic cable installations.
3. Electronic measurement of the distance and equivalent attenuation per kilometer (km) to verify minimum data transmission capacity per specification.
4. Total link attenuation measurements.

C.2 Test Equipment

The following test equipment shall be used:

1. Fluke DSP 4300 Level III, or equal, tester with single mode and multi-mode power meter and light source heads
2. Fluke, or equal, OptiFiber Optical Time Domain Reflectometer (OTDR)

C.2.1 Cabling Distance

Section 27 1513 states that the maximum allowable multimode cable distance from MDF to IDF is 450 meters. The Multimode strands shall primarily be utilized by the network electronics up to 450 meters and testing shall conform to OFSTP-14A. The Singlemode strands shall be required where cabling the Backbone distance exceeds 450 meters and testing shall conform to OFSTP-7.

C.2.2 Cable Attenuation

The list below details the information presented in TIA/EIA - 568B.3 to illustrate the allowable attenuation per kilometer for 50/125, 62.5/125 and 9 μm fiber.

Table C.2.2-1. Maximum Cable Attenuation Coefficient for Backbone Fiber

MAXIMUM ATTENUATION RANGE	ALLOWABLE ATTENUATION
50/125 μm @ 850nm	3.5 dB/km
50/125 μm @ 1300nm	1.5 dB/km
62.5/125 μm @ 850nm	.5 dB/km
62.5/125 μm @ 1300nm	.5 dB/km
9 μm @ 1310 nm (indoor)	1 dB/km

9 μ m @ 1550 nm (indoor)	1 dB/km
9 μ m @ 1310 nm (indoor)	1 dB/km
9 μ m @ 1550 nm (indoor)	1 dB/km

C.2.3 Connector Attenuation

Per ANSI/EIA/TIA-455-59, the maximum optical attenuation per connector pair shall not exceed 0.75 dB.

C.3 Test Procedures

For multi-mode fiber the Owner's Quality Assurance Team shall use the Omni Scanner 2 to test the length and total attenuation at both the 850 nm and 1300 nm wavelengths in each direction (bi-directionally). If the test fails, the Owner's Quality Assurance Team shall complete a repeat test using the OTDR to assess the failure point and address corrective actions. (See Methods A and B attached.)

For single-mode fiber, the Owner's Quality Assurance Team shall use a power meter and light source. The specific nanometer wavelength(s) at which the single-mode fiber shall be tested (i.e., 1310 nm and/or 1550 nm) shall be determined based on the length of the fiber cable being tested.

C.3.1 Cable Distance

Using the Omni Scanner 2 or OTDR, the Owner's Quality Assurance Team shall determine the overall fiber optic cable length to ensure the cabling distance is within the maximum allowable length.

C.3.2 Attenuation

TIA/EIA-568-B.1 section 11.3.3, states, "When installing components compliant with this standard, the single performance parameter necessary for performance testing is link attenuation." Also "The backbone optical fiber cabling link segment should be tested in one direction at both operating wavelengths, to account for attenuation deltas associated with wavelength.

1. 50/125 μ m backbone links shall be tested at 850 and 1300 nm in accordance with ANSI/EIA/TIA-526-14-A, Method B, with One "Reference Jumper."
2. 62.5/125 μ m backbone links shall be tested at 850 and 1300 nm in accordance with ANSI/EIA/TIA-526-14-A, Method B, with One "Reference Jumper."
3. 9 μ m backbone links shall be tested at 1310 and 1550 nm in accordance with ANSI/EIA/TIA-526-7, Method A.1."

The Owner's Quality Assurance Team shall use the Omni Scanner 2 or OTDR to measure the attenuation due to fiber optic cable and connectors. The Owner's Quality Assurance Team shall test and record attenuation at both 850nm/1300nm for each Multi-mode and 1310nm/1550nm for Single-mode fiber optic strand respectively terminated under this initiative.

These tests shall be performed at each communications cabinet and from the MDF cabinet, as required.

C.3.3 Information Transmission Capacity

The fiber optic cable is assumed to be within the allowable attenuation per kilometer as specified in TIA/EIA-568-B.1 section 11.3.3.4. The Owner's Quality Assurance Team shall presume the transmission capacity of the cable is within specification.

C.4 Data Reporting and Accuracy

The Owner's Quality Assurance Team shall report loss measurement results, with locations and wavelength identifications, to the Owner in accordance with EIA/TIA OFSTP-14 and OFSTP-

Figure C - Testing Methods A, B and Adaptive B

1. Diagrams and Explanations for testing

C.5 Fiber Optic Cable Installation Test Forms

The following pages provide the two fiber optic cable installation test forms:

1. Fiber Optic Cable Installation Test Form—OTDR
2. Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Figure C - Method A, Method B and Adapted Method B Explained Solution

The testing of premises fiber optic cabling links requires precise methods for referencing to obtain accurate and valid test results. Loss testing for multimode fiber cabling is specified in ANSI/TIA/EIA-526-14A. This standard contains two test procedures: Method A and Method B. This article describes Methods A and B, and explains why Method B is the proper method for testing fiber links contained in premises networks.

This article also proposes a new test procedure as an adaptation to Method B to overcome some disadvantages associated with Method B. This new test procedure is the preferred method because it provides results conforming to Method B while offering installers more flexibility for testing fiber links with types of connectors, including Small Form Factor (SFF) connectors. This article also details other advantages of the Method B adaptation for simplifying the testing process and reducing the opportunity for errors.

Method A

Method A is used for testing links in which the total attenuation is dominated by the loss in the fiber cable, rather than the loss of the connectors, as is often the case for telecom networks. The referencing procedure for Method A uses two patch cords and an adapter connector per fiber link to be tested (See Figure 1).

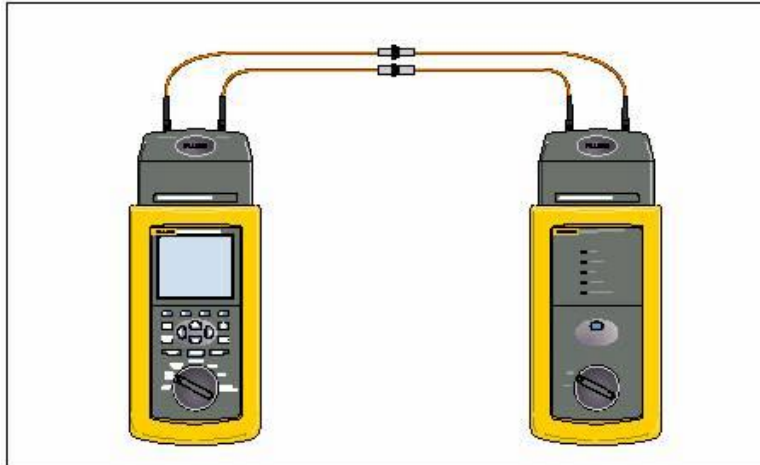


Figure 1 - Reference Configuration with a Dual Fiber Tester Simultaneously Testing Two Fiber Links

The two patch cords and one adapter connection are referenced out when the test is performed. Therefore, the test results include the loss of the fiber link under test plus only one connection (Note the blue section in Figure 2).

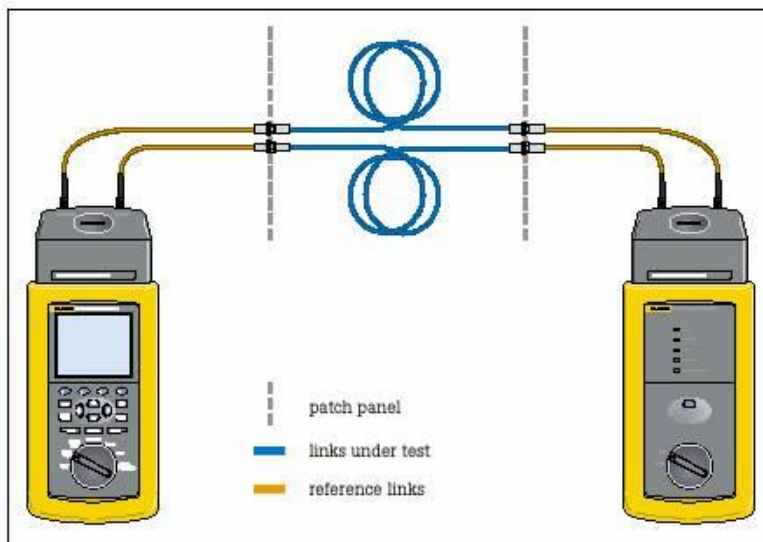


Figure 2 - Test Configuration with Dual Fiber Tester

While this method has been used effectively in the testing of long haul telecom fiber links, it is less precise than what is necessary for the premises market today. Because the network operation actually sees the loss of the fiber link plus the connections at both ends, Method A understates the power loss in the link since it includes only one connection. For long-haul telecom links, this is not an issue since the majority of the loss is in the long lengths of fiber with minimal loss in the precision connectors.

However, in premises applications, fiber lengths are very short and the amount of loss in the fiber cable itself is minimal. The majority of power loss is found in the connections at either end. The increasingly stringent power loss budgets of applications like Gigabit Ethernet require that the entire link loss be measured. That is where Method B becomes applicable.

Method B

Method B is used for testing links for which the connector loss is a significant portion of the total attenuation. This is the case for premises links. The referencing procedure for Method B uses one patch cord per fiber link to be tested (See Figure 3). (Note: This figure depicts a dual fiber tester that tests two fiber links at a time.)



Figure 3 - Method B Reference Configuration

Since only one patch cord (per link) is part of the reference, the test results shall include loss from the fiber cable under test plus the connections at BOTH ends (see blue section in Figure 4).

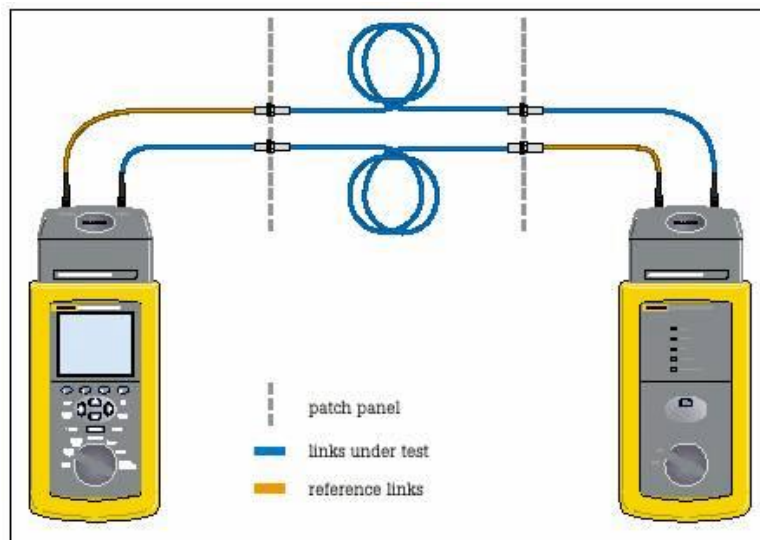


Figure 4 - Method B Test Configuration

Technically, it shall also include any loss in the additional patch cord but this is negligible because the length is so short.

For premises fiber networks, this method provides an accurate measure of the loss in the fiber link because it includes the fiber cable plus the connections at BOTH ends. However, when using Method B, be aware of the following shortcomings:

1. When going from the reference setup to the test setup, it is necessary to disconnect one end of the patch cords from the tester. It is very important never to disturb the connection at the OUTPUT or source end. If this connection is disrupted, the reference is lost, and proceeding without re-referencing shall seriously compromise the test results. Unfortunately, one could easily disconnect the patch cord from the source (OUTPUT) end instead of from the detector (INPUT) end.
2. Although you must disconnect the patch cords from the detector (INPUT) end of the tester, extreme care is required as dirt and other elements can cause damage to the detector.
3. To test Small Form Factor (SFF) connectors that have the transmit and receive fibers in the same connector, you are forced to disconnect from the source (OUTPUT) end in violation of proper referencing and test procedures.
4. Using Method B requires that you have the same type of connector on the tester as you shall be testing in the fiber link.

Presented in the next section is a new test procedure that is an adaptation to Method B, but provides the same test results and preserves integrity to testing Standards while overcoming the short-comings listed above.

Adaptation to Method B

A simple adaptation to Method B allows us to retain the accuracy (every measurement includes the cable and both connections) but avoid the major disadvantages.

The referencing procedure for this adaptation is performed using 2 patch cords and an adapter connector per fiber link to be tested (See Figure 5).



Figure 5 - Adaptation to Method B Reference Configuration

However, the test procedure is new, and is depicted in Figure 6.

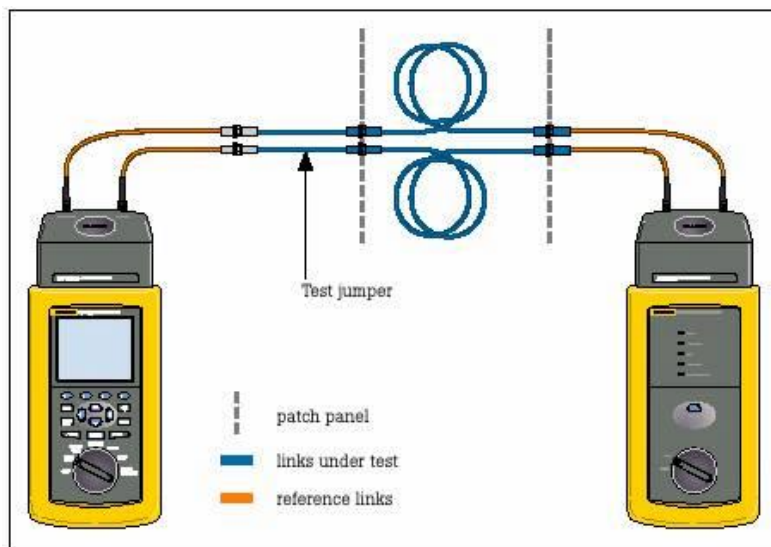


Figure 6 - Adaptation to Method B Testing Configuration

The test procedure includes the addition of a short test jumper with a connector so that the test results shall now be the same as the test results obtained with Method B. Just like Method B, the results contain the loss for the fiber cable plus the connections on BOTH ends (note the blue section in Figure 6). The two patch cords and one connection per link from the reference setup have been referenced out.

Make the Correct Loss Measurements

The Method B adaptation gives us several key advantages over the original Method B while preserving its accuracy:

The Method B adaptation gives loss results that conform to ANSI/TIA/EIA-526-4A, Method B. According to Method B, to measure the link loss correctly, the test path must have two more adapters in each fiber link than in the Set Reference path. The test procedure described in this article adheres precisely to this requirement. In this way, the measured loss shall be the loss of the fiber in a link plus the loss of a connection at each end of the link. This value of loss is the real value encountered by network application hardware.

The Method B adaptation allows the use of hybrid patch cables to connect test equipment to the links under test. This allows consistent testing of links with all types of connectors, including those that use small form-factor (SFF) connectors.

Preserve the Integrity of your Test

The adaptation to Method B makes it unnecessary to disconnect the patch cords from the test equipment, thereby reducing the possibility of errors caused by reinsertion of patch cords or by contamination or damage of test equipment fiber interfaces.

C.5.1 Fiber Optic Cable Installation Test Form—Omni Scanner 2 and OTDR

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Omni Scanner2 Serial #: _____ Omni Scanner2 Location _____ Distant End Location _____

OTDR Serial #: _____ Near End TFBM Serial #: _____ Distant End TFBM Serial #: _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments
850	1-blue					850	13-blue				
1300						1300					
850	2-orange					850	14-orange				
1300						1300					
850	3-green					850	15-green				
1300						1300					
850	4-brown					850	16-brown				
1300						1300					
850	5-slate					850	17-slate				
1300						1300					
850	6-white					850	18-white				
1300						1300					
850	7-red					850	19-red				
1300						1300					
850	8-black					850	20-black				
1300						1300					
850	9-yellow					850	21-yellow				

Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments
1300						1300					
850	10-violet					850	22-violet				
1300						1300					
850	11-rose					850	23-rose				
1300						1300					
850	12-aqua					850	24-aqua				
1300						1300					

C.5.2 Fiber Optic Cable Installation Test Form—Power Meter and Light Source

Site _____ Q/A Rep(s) _____ Date _____ Q/A Review Form: Pass / Fail

Power Meter Serial #: _____ Power Meter Location _____

Light Source Serial #: _____ Light Source Location _____

Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓	Disk	Comments
1310	1-blue					1310	13-blue				
1550						1550					
1310	2-orange					1310	14-orange				
1550						1550					
1310	3-green					1310	15-green				
1550						1550					
1310	4-brown					1310	16-brown				

Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments	Wave-length (nm)	Strand	Length (m)	Total Attn (dB) ↑ ↓		Disk	Comments
1550							1550						
1310	5-slate						1310	17-slate					
1550							1550						
1310	6-white						1310	18-white					
1550							1550						
1310	7-red						1310	19-red					
1550							1550						
1310	8-black						1310	20-black					
1550							1550						
1310	9-yellow						1310	21-yellow					
1550							1550						
1310	10-violet						1310	22-violet					
1550							1550						
1310	11-rose						1310	23-rose					
1550							1550						
1310	12-aqua						1310	24-aqua					
1550							1550						

APPENDIX D - NETWORK EQUIPMENT PERFORMANCE TESTS

D.1 Overview of Equipment Tests

These equipment tests verify the operation of the network components (e.g., switches, and routers) either purchased or provided for use as part of the particular project. This plan addresses industry-standard TCP/IP tests that collectively address Network layer connectivity and IP packet path routing; it does not address network performance (i.e., total throughput capabilities) tests.

The Owner's Quality Assurance Team shall perform the following interrelated tests:

1. Spanning Tree Root Bridge identification test. Spanning tree protocol is one of the most important layer 2 protocols at work in switches. Spanning Tree ensures that no loops occur in a network by a designated root bridge. The root bridge is a central point of a spanning-tree configuration and it controls how the protocol operates. It is best practice to configure the core switch to be the root bridge. Run the following command on the core switch to identify it is set as the root bridge: Show spanning-tree summary.
2. Internet Control and Message Protocol (ICMP) Ping Test. This test verifies the Network layer for connectivity by using Ether-type frame pings to reach IP target addresses and obtain or verify four results—the target IP address, the local media access control (MAC), the number of responses, and the response time. The target IP addresses are the upstream and/or downstream gateway IP addresses based on the device's connectivity in the network. The source is the management console on the device. Each test includes two steps, if necessary, as follows:
 - a. Obtain the four results by performing an address resolution protocol (ARP) for the target IP address and verifying the ping.
 - b. If test 1 is unsuccessful, obtain the four results by executing an ARP for the default router, then use the acquired MAC address to determine the IP address, send an ICMP echo request and monitor for the ICMP reply.
3. Trace Route/Path Discover. This test determines the path IP packets follow, and reports each router encountered in the path. Testing elicits an ICMP TIME-EXCEEDED response from each router encountered. Each hop is tested three times to help identify changing routes.
4. Configuration Test. This test verifies that each new network port is operational. Perform an ICMP ping from each port not previously tested, ensuring each port has a link light indicating port operability.
5. VLAN configuration verification. Inspect VLAN configuration and port assignments to be matching the provided documentation. Inspect VLAN trunking, and verify forwarding state of required VLANs on VLAN trunks.

D.2 Test Equipment

The following test equipment shall be used:

1. Fluke 682 Enterprise LAN Meter or equivalent.
2. Computer with TCP/IP protocol stack, TELNET application and data capture software (optional).

D.3 Test Methodology

The basic test methodology is to verify connectivity from user access ports through and within the installed intra-network to the WAN Router. Overall connectivity is verified by testing to and from points in the network. Site testing reflects the specific switch(s) and router(s) implemented at the site.

D.4 Test Hierarchy for Connectivity (Pings, Trace Routes and Telnets)

Table D.4-1 contains the network equipment performance tests and corresponding descriptions.

Table D.4-1. Network Equipment Performance Tests

TEST	TEST DESCRIPTION
Ping from Wall outlet WAN or Internet location	Connect the computer into the network via the wall plate, obtain DHCP IP address and perform a ping to a known IP address or URL outside the campus network.

D.5 Network Equipment Configuration Verification and Performance Tests

The Owner's Quality Assurance Team shall follow the test sequence shown. The following sample form lists tests to be performed at this site. For the set of Network Equipment Performance Test forms tailored to the individual communications cabinets, please see enclosed file Network Checklists.doc.

D.5.1 Network Equipment Configuration Verification Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

Device Name/IP	Type of device	Type of Configuration verified	PASS	FAIL
	Ethernet Switch	VLAN / STP/ port activation/ Trunking		
	Ethernet	VLAN / STP/ port activation/		

	Switch	Trunking		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		
	Router/ L3 switch	IP Routing/ SNMP/ Access-lists		

D.5.2 Network Equipment Performance Test Form

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers _____

(a packet loss in excess of 1% during ping test is not acceptable and is considered a FAIL)

TEST	SOURCE ADDRESS/LOCATION	DESTINATION ADDRESS/LOCATION	PASS	FAIL
Ping from Wall outlet to WAN Router location				
Trace route from Wall outlet to WAN Router location				

E.1 Overview of Physical Connectivity Audit

E.2 Physical Connectivity Audit Quality Assurance Review lists

Site _____ Date _____ Tester(s) _____

Building and Communications Cabinet Numbers

APPENDIX F - CABLE DOCUMENTATION SPECIFICATION

F.1 Documentation.

- F.1.1** The test result information for each link shall be recorded in the memory of the field tester upon completion of the test.
- F.1.2** Individual test reports shall be submitted in hardcopy and electronic format. Hand-written test reports are not acceptable.
- F.1.3** The test results records saved by the tester shall be transferred into a Windows™-based database utility, such as MS Access, or SQL, or MS Excel spreadsheet, that allows for the maintenance, review and archiving of these test records. A guarantee must be made that the measurement results are transferred to the PC unaltered, i.e., “as saved in the tester” at the end of each test and that these results cannot be modified at a later time.
- F.1.4** Hardcopy reports may be submitted in labeled 3 ring binders with an attached affidavit verifying passing execution of tests. For large installations electronic reports with hardcopy summaries are preferred. Hardcopy summary reports shall contain the following information on each row of the report: circuit ID, test specification used, length, and date of test and pass/fail result.
- F.1.5** Electronic reports are to be submitted in CD format. If proprietary software is used, disk or CD shall contain any necessary software required to view test results. If the results are delivered in a standard format like Excel, Access, CSV files, etc., then software to read these files is not needed. Electronic reports must be accompanied by a Certificate signed by an authorized representative of the Contractor warranting the truth and accuracy of the electronic report. Certificate must reference traceable circuit numbers that match the electronic record.
- F.1.6** Test reports shall include the test measurement information specified in Section 5 for each cabling element tested, in addition to:
- F.1.7** Cable manufacturer, cable model number/type and NVP.
- F.1.8** Tester manufacturer, model, serial number, hardware version and software Ver. 6.
- F.1.9** Circuit ID number.
- F.1.10** Auto test specification used.
- F.1.11** Identification of the tester interface.
- F.1.12** Overall pass/fail indication.
- F.1.13** Date and time of test.

Table F.2 Cable Test Parameter Preferences

When reading the printed test result output, the following parameters must be shown with the associated cable test.

Cable Testing Parameter Preferences
--

Cable Test	NVP	Cable	Auto test	Fiber Type	GRI	Reference	Test Direction	Pulse Width
Level (IIE) Category 5 E Tester	69 – 72	Cat 5E	Cat 5E Perm link	n/a	n/a	n/a	n/a	n/a
Level (III) Category 6 Tester	69 – 72	Cat 6	Cat 6 Perm link	n/a	n/a	n/a	n/a	n/a
Power Meter Horizontal MM F/O @ 850nm/1300nm	n/a	62.5/12 5 Mnfr	568B Horizontal	Multimod e 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Direction al	n/a
Power Meter Backbone MM F/O @ 850nm/1300nm	n/a	62.5/12 5 Mnfr	568B Backbone	Multimod e 50 or 62.5	1.4920 @ 1300nm	1 jumper method	Bi- Direction al	n/a
Power Meter Backbone SM F/O @ 1310nm/1550 nm	n/a	SM Mnfr	1000 Base –LX	Single Mode	1.4640 @1300nm	1 jumper method	Bi- Direction al	n/a
OTDR Horizontal MM F/O @ 850nm/1300nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Direction al	<50ns
OTDR Backbone MM F/O @ 850nm/1300nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Direction al	<50ns
OTDR Backbone SM F/O @ 1310nm/1550 nm	n/a	n/a	n/a	Single Mode	n/a	n/a	Uni- Direction al	<50ns

NOTE: The length of the cable is the variable of which the Power Meter and light source determines the expected dB loss for Backbone cable tests.

Table F.3 Allowable Distance per Fiber Length

Use this table as a guideline to compare references for dB loss in the installed Backbone Fiber. Total loss includes .75 dB loss per mated connector pair.

Fiber Cable Distance	Multimode dB Loss	Singlemode DB Loss		Fiber Cable Distance	Multimode dB Loss	Singlemode DB Loss
100'	1.6	1.53		1200'	2.7	1.86
200'	1.7	1.56		1300'	2.8	1.89
300'	1.8	1.59		1400'	2.9	1.92
400'	1.9	1.62		1500'	3.0	1.95
500'	2.0	1.65		1600'	3.1	1.98
600'	2.1	1.68		1700'	3.2	2.01
700'	2.2	1.71		1800'	3.3	2.04
800'	2.3	1.74		1900'	3.4	2.07
900'	2.4	1.77		2000'	3.5	2.10
1000'	2.5	1.80		2100'	3.6	2.13
1100'	2.6	1.83		2200'	3.7	2.16

SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Sleeves for raceways and cables.
 - 2. Sleeve seals.
 - 3. Grout.
 - 4. Common electrical installation requirements.

1.2 SUBMITTALS

- A. Product Data: For sleeve seals.

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, **available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:**
 - 2. Basis-of-Design Product: Subject to compliance with requirements, provide **product indicated on Drawings** or comparable product by one of the following:
 - a. Advance Products & Systems, Inc.

- b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
- 3. Sealing Elements: **EPDM/NBR** interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 4. Pressure Plates: **Plastic, Carbon steel or Stainless steel**. Include two for each sealing element.
 - 5. Connecting Bolts and Nuts: **Carbon steel with corrosion-resistant coating and/or Stainless steel** of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors **2 inches** above finished floor level.
- G. Size pipe sleeves to provide **1/4-inch** annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using **steel** pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for **1-inch** annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for **1-inch** annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 26 05 13 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Boxes, enclosures, keys and locks.
 - 2. Receptacles and switches.
 - 3. Identifications and signs.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Division 26 - Electrical.
 - 3. Division 27 - Communications.
 - 4. Division 28 - Electronic Safety and Security.

PART 2 - PRODUCTS

2.1 BOXES, ENCLOSURES, KEYS AND LOCKS

- A. Outlet Boxes and Fittings:
 - 1. Outlet boxes installed in concealed Work shall be galvanized steel, pressed, or welded type, with knockouts.
 - 2. In exposed Work, where conduit runs change direction or size, outlet boxes and conduit fittings shall be cast metal with threaded hubs cast integral with box or fitting.
 - 3. Fittings shall be cast metal and non-corrosive. Ferrous metal fittings shall be cadmium-plated or zinc galvanized. Castings shall be true to pattern, smooth, straight, with even edges and corners, of uniform thickness of metal, and shall be free of cracks, gas holes, flaws, excessive shrinkage, and burnt-out sand.
 - 4. Covers for fittings shall be galvanized steel or non-corrosive aluminum and shall be designed for particular fitting installed.
 - 5. Light fixture outlets shall be 4-inch octagon, 4-inch square, 2 1/8-inch deep or larger, depending upon number of conductors or conduits therein. Plaster rings shall be furnished with round opening with two ears drilled 2 23/32 inches center to center.
 - 6. For local device outlets provide 4-inch square 2 1/8-inch deep, boxes for single gang, 5-inch square boxes for two-gang, and special solid gang boxes with gang plaster ring for more than two switches.
 - 7. For TV outlets, and horns and strobes provide manufacturer's supplied back box as needed. For television outlets, provide 4-gang deep boxes and 4-gang plaster rings.
 - 8. Plaster rings shall be provided on flush-mounted outlet boxes except where otherwise indicated or specified. Plaster rings shall be same depth as finished surface. Install approved ring extension to obtain depth to finish surface.
 - 9. In existing plywood wall or drywall construction, and where flexible steel conduit is fished into walls, single-gang and 2-gang outlets for wiring devices may be sectional

- steel boxes with plaster ears. Boxes shall be fastened to plywood with flat-head screws in each plaster ear screw hole. Boxes fastened to gypsum board shall be Racor, Appleton, Cooper, Bowers, or equal.
10. Factory made knockout seals shall be installed to seal box knockouts, which are not intact.
 11. Where flexible conduit is extended from flush outlet boxes, provide and install weatherproof universal box extension adapters.
- B. Junction and Pull boxes:
1. Junction and pull boxes, in addition to those indicated, shall only be used in compliance with codes, recognized standards, and Contract Documents.
 2. Interior and non-weatherproof boxes shall be constructed of blue or galvanized steel with ample laps, spot welded, and shall be rigid under torsion and deflecting forces. Boxes shall be furnished with auxiliary angle iron framing where necessary to ensure rigidity.
 3. Covers shall be fastened to box with a sufficient number of machine screws to ensure continuous contact all around. Flush type boxes shall be drilled and tapped for cover screws if boxes are not installed plumb. Surfaces of pull and junction boxes and covers shall be labeled in black marker ink designating system, panelboard and circuit designation contained in box. In exposed Work, designation shall be installed on inside of pullbox or junction box cover.
 4. Weatherproof NEMA 3R pull and junction boxes shall conform to foregoing for interior boxes with following modifications:
 - a. Cover of flush mounting boxes shall be furnished with a weather-tight gasket cemented to, and trimmed even with, cover all around.
 - b. Surface or semi-flush mounting pull and junction boxes shall be UL, or another Nationally Recognized Testing Laboratory (NRTL) listed as rain-tight and shall be furnished complete with threaded conduit hubs.
 - c. Exposed portions of boxes shall be galvanized and finished with one prime coat and one coat of baked-on gray enamel, unless already furnished with factory baked-on finish.
 5. Junction and pull boxes shall be rigidly fastened to structure and shall not depend on conduits for support.
 6. Underground Concrete Pull Boxes:
 - a. Pre-cast concrete pull boxes. Concrete pull boxes shall be traffic type, reinforced for H-20 wheel loading, pre-cast concrete. Pull boxes with inside dimensions of 2 feet by 3 feet by 3 feet deep shall consist of a base section, top ring, and cover. Base section shall be furnished with 2 knockouts measuring 10 inch by 10 inch in each 3 feet side, and one 20 inch by 20 inch knockout in each 2-foot side. Pull boxes with inside dimension 4 feet by 4 feet by 4 feet deep shall consist of a base section, midsection, topping, and cover. Base section shall be furnished with 2 knockouts measuring 8-inch by 16-inch on each of two opposite sides, and one 20-inch by 20-inch knockout on each of other two opposite sides. Pull boxes shall be furnished with a minimum of 6-inch diameter sump knockout and one inch diameter ground rod knockout. In pull boxes, furnish and install cable racks on walls. Racks shall be furnished with 3 porcelain cable holders on vertical steel mounting bars. Pull boxes shall be furnished with 3/4 inch diameter pull irons. Covers shall be traffic-type consisting of steel safety plate bolted to frame. Covers shall be marked as

- electrical, power, or signal as required. Pull boxes shall be as manufactured by Oldcastle Precast, Jensen Precast, Kistner, Western Precast, or equal.
- b. Provide end bells in duct entrances. Terminate each metal conduit with insulated bushing provided with a grounding terminal.
 - c. Install pulling irons on opposite walls and below horizontal centerlines of ducts and bricked-up openings, and in bottom. Install pulling irons with each end hooked around a reinforcing bar.
 - d. Remove floor drain knockout and provide a depth of 24 inches of crushed rock below box extending a minimum of 12 inches beyond on all sides.
 - e. Permanently and effectively ground metal equipment cases, cable racks, and similar items in pull boxes to site grounding electrode system. Provide grounding conductor in compliance with CEC Article 250.
 - f. Provide 6-inch deep sand base under pull boxes.
 - g. Identify power and signal cables by tagging in manholes and pull boxes. Tie securely to cables with nylon cord.
 - h. Top of steel plate shall provide a minimum coefficient of static friction of 0.5 for either wet or dry locations, when tested for any shoe sole material. Test shall comply with ASTM D 1047 or F 489 or F 609 standards. Submit manufacturer's test results for Architect's review as part of materials and equipment submittals.
 - i. The use of underground extension boxes shall be limited to not more than 1 times the original depth of pull box.
7. Underground utility boxes shall be reinforced concrete with non-setting shoulders to prevent settlement following installation. Boxes shall be furnished with cast iron cover with finger hole, size as indicated on Drawings. Utility boxes shall be as manufactured by Oldcastle, Jensen, Kistner, Western Precast, or equal.
 8. Manholes, vaults, and pull boxes required by a utility company, and installed as part of this Contract, shall meet requirements of servicing utility company.

C. Floor Outlets:

1. Provided floor outlets, except for extension outlets, shall be Harvey Hubbell Inc. B-2503, Thomas & Betts 640 series, Legrand Omnibox, or equal, adjustable, cast iron, watertight floor boxes with flush brass floor plates, and shall be set to finish flush with finish floor covering, whether it be carpeted, wood, resilient floor covering, or other finish materials. Floor boxes shall be used in office, classrooms, and in library areas only.
2. Telephones above floor outlets, where not subjected to water, shall be provided with Harvey Hubbell Inc. SC-3098 pedestals with SC309T plates, Legrand 525 series, Thomas & Betts FPT-400 Series, or equal. Refer to other Division 26 sections. Floor boxes shall be used in office, classrooms and in Library areas only.
3. Plugs above floor outlets where not subjected to water shall be provided with Legrand 525 series, Thomas & Betts FPT-400 Series, Harvey Hubbell Inc. SC-3098, or equal, pedestal and with SS309D, or equal, device plates. Refer to other Division 26 sections. Floor boxes shall be used in office, classrooms, and library areas only.
4. Plugs above floor outlets where subjected to water shall be provided with a Harvey Hubbell Inc. SA-6685 or equal, single-gang outlet box, or SA-6687 or equal, 2-gang outlet box. Provide required cover plate. Refer to other Division 26 sections. Floor outlets shall be used in Cafeteria, Cafeteria serving areas, or any areas where floors are subjected to water.

5. Furnished extension floor outlets shall be cast iron floor boxes with cast iron covers and 1/2 inch offset entries for above-floor conduit extensions; Harvey Hubbell F3186, or equal. Boxes shall be designed to permit access to wiring without disturbing above-floor extensions and shall be set flush with finish floor.
6. Furnished above floor service fittings for surge suppression receptacles shall be Hubbell SC3098 with cover plates SS309DS, Legrand 525 series, Thomas & Betts FPT-400 Series, or equal.
7. Furnished above floor service fittings for data outlets shall be Hubbell SC3098 with required cover plates, Legrand 525 Series, Thomas & Betts FPT-400 Series, or equal. Refer to other Division 26 sections.

D. Floor Pockets:

1. Three-Gang: Furnished three-gang floor lighting pockets shall be flush floor type, with cast iron floor plate and hinged cast iron door notched for cables. Three-gang floor pockets shall be owner approved Legrand or Hubbell Recessed Floor Boxes, C.W. Cole TLS-353-6, or equal, for wood floors and C.W. Cole TLS-353-6-C, or equal, for concrete slabs. Each floor pocket shall be provided with three 20 amp, 3 wire, 125 volt receptacles with matching caps.
2. Single Gang:
 - a. Receptacle floor pockets shall be single gang, flush floor type, with cast iron floor plate, hinged cast iron door notched for cable and cast iron box; C.W. Cole TLA-362-1-FE, or Owner approved Legrand or Hubbell recessed floor box or equal. Provide each pocket with a standard, single grounding type receptacle unless otherwise indicated. Provide C.W. Cole TLS-362-1, or equal, in wood floors.
 - b. Microphone or projector floor pockets shall be single gang flush floor type with cast iron floor plate, hinged cast iron door, notched for cable and cast iron box, or owner approved Legrand or Hubbell recessed floor box, C.W. Cole TLA-362-3-FE, C.W. Cole TLS-362-3, in wood floors, or equal.

E. Keys and Locks:

1. Provide two keys with furnished door locks, including cabinet door locks and switchboard locks, two keys for lock switches on switchboards or control panels, and two keys with interlocks or other furnished lock switches. Deliver keys to OAR.
2. Locks shall be keyed to Corbin No. 60 keys for access to operate equipment and Corbin 70 keys for service access. Special keys and locks shall only be provided where specified.

2.2 RECEPTACLES AND SWITCHES

A. Receptacles:

1. Duplex receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wired with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be PVC. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20	PS5362-I	HBL5362-I	5362-I
(15 amps) NEMA 5-15	PS5262-I	HBL5262-I	5262-I

2. Duplex receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour model number PS5262BL (blue), Hubbell DRUBTVSS15, Leviton 5262-SBU, 15 amps, 120 volts, or equal.
3. Single receptacles shall be heavy-duty specification grade, grounding type. Terminal screws shall be back and side wire with internal screw pressure plates. Mounting strap shall feature heavy-duty brass construction. Receptacle back body shall be thermoplastic. Receptacle face shall be ivory, impact resistant nylon. Receptacles shall have triple wipe brass power contacts. For circuits consisting of one single receptacle only, ampere rating of receptacle shall be same as circuit breaker or fuse.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5361-I	HBL5361-I	5361-I
(15 amps) NEMA 5-15R	5261-I	HBL5261-I	5261-I

4. 15 and 20 amps single receptacles on circuits supplied by panel boards with integral surge suppression shall be Pass & Seymour NEMA 5-20R model number 5361-BL (blue), and NEMA 5-15R model number 5261-BL (blue) respectively. Equal receptacles by other Owner approved manufactures are acceptable.
5. For kiln receptacles and range receptacles, provide 3-pole, 4-wire, grounding type, rated 50 amps at 125/250 volts NEMA 14-50R. Provide with 2-gang, stainless steel plates, SS 703, or equal.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 14-50R	3894	HBL9450A	279
WALL PLATE	SS703	S703	84026

6. For dryer receptacles, provide 3-wire, non-grounding type, rated 30 amps at 125/250 volts, NEMA 10-30R, with 2-gang stainless steel plates. Coordinate location of junction box with the work of Section 10 2815, Hand and Hair Dryers.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 10-30R	3860	HBL9350	5207
WALL PLATE	SS703	S703	84026

7. Provide specification grade ground-fault circuit interrupter (GFCI) type receptacles in accordance with 2010 UL standards. GFCI receptacles shall have a trip indication light. Receptacle terminal screws shall be back and side wire with internal screw pressure plates. Test and reset buttons shall match device body and shall be ivory. GFCI receptacles shall be manufactured in standard configuration for installation with stainless steel smooth plates. Exterior mounted receptacles shall be mounted inside weatherproof enclosure.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
NEMA 5-20R	2095-I	GFR5352-IA	7899-I
NEMA 5-15R	1595-I	GFR5252-IA	8598-I

8. Provide weatherproof receptacles, except where otherwise indicated or specified, consisting of GFCI receptacles, as specified herein, and metal plates with die-cast lockable hinged lids and weatherproof mats;
9. In Kindergarten and Early Education Center Classrooms provide tamper-resistant receptacles with thermoplastic dual mechanism shutter system to help prevent insertion of foreign objects. Receptacles shall have extra heavy-duty brass, one-piece mounting strap with integral ground. Receptacles shall be ivory color, impact resistant nylon face and back body. For tamper-resistant receptacles rated 20 amps/125 volts, provide NEMA 5-20R, ivory in color,. For tamper-resistant receptacles rated 15 amps/125 volts, provide NEMA 5-15R, ivory in color.

<u>NEMA #</u>	<u>Pass & Seymour</u>	<u>Arrow Hart</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	TR63-I	TR8300V	8300SGI

(15 amps) NEMA 5-15R TR62-I TR8200V 8200SGI

10. Provide transient voltage surge suppression (TVSS) receptacles offering metal oxide varistors (MOVs) protecting normal and common modes, (L-N, L-G, N-G) with 500V suppressed voltage. TVSS devices shall offer 3-mode equal protection with 210 joules minimum per mode of energy absorption and 13,000 amp maximum surge capability. TVSS devices shall have 3 thermal fuses and two over-current protection fuses. TVSS devices shall have LED visual only surge status indicator to alert user to surge suppression circuit condition. Visual indicator will be illuminated (red) when power is on and surge suppression circuit is fully functional. Visual indicator will not be illuminated when power is off or unit experiences loss of surge suppression protection. Terminals shall be back and side wire including ground terminal. Color shall be blue.

<u>NEMA #</u>	<u>Pass& Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
(20 amps) NEMA 5-20R	5352BLSP	HBL5360SA	5380B
(15 amps) NEMA 5-15R	5252BLSP	HBL5260SA	5280B

11. Receptacles within 6 feet of water fountains, counter tops, or any sources of water shall be GFCI type.

B. Switches:

1. Local Switches:

- a. Provide local switches, high strength thermoplastic toggle, specification industrial grade, rated 20 amps at 120-277 volts AC only, with plaster ears, external screw pressure plate back and side wired, and standard size composition cups which fully enclose mechanism. Switches shall be approved for installation at currents up to full rating on resistive, inductive, tungsten filament lamp and fluorescent lamp loads, and for up to 80 percent of rating for motor loads. Switches shall have oversized silver alloy contacts for long life and better heat dissipation. Provide switches as single pole, double pole, 3-way, 4-way, non-lock type. Provide non-lock type switches with ivory handles;

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1I	HBL1221I 1221-2I
Double pole	PS20AC2I	HBL1222I 1222-2I
Three way	PS20AC3I	HBL1223I 1223-2I
Four way	PS20AC4I	HBL1224I 1224-2I

- b. Provide lock type switches, specification industrial grade, 20 amp, 120-277 volts with metal or nylon key guides with on/off indication, and operable by same key. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16-inch long forks, 5/32-inch spacing between forks and 5/16-inch width overall.

<u>Pass & Seymour</u>	<u>Arrow Hart</u>
Single pole	PS20AC1L w/#500 Key-2L 1221L w/1201LK Key
Double pole	PS20AC2Lw/#500 Key 1222L w/1201LK Key
Three way	PS20AC3L w/#500 Key 1223L w/1201LK Key
Four Way	PS20AC4L w/#500 Key 1224L w/1201LK Key

- c. Rotary lock switches shall incorporate a tumbler type lock to prevent unauthorized operation. Lock shall be tumbler type by Corbin, keyed to a HH41 key. Lock switch to be installed with pin tumblers facing downward. Key shall be removable in all positions. Each device shall be complete with 2 keys. Keys shall be delivered only to the OAR. Switches shall be rated at 20 amps, 120-277

volt AC. Switch plates shall be of stainless steel, engraved with on and off positions indicated.

Arrow Hart

Single pole AH1191N

Double pole AH1192N

Three way AH1193N

- d. Pilot light switches shall be rated 20 amps and shall conform to specifications for local switches. Switches shall be furnished with red, Lexan handles that are lighted by long-lasting neon lamps. Pilot light shall light when load is on. Pilot light 120 volt switches

<u>Pass & Seymour</u>		<u>Hubbell</u>	<u>Leviton</u>
Single pole	PS20AC1-RPL	HBL1221-PL	1221-PLR
Double pole	PS20AC2-RPL	HBL1222-PL	1222-PLR
Three way	PS20AC3-RPL	HBL1223-PL	1223-PLR

Same as above except rated at 20 amps at 277 volts.

<u>Pass & Seymour</u>	<u>Leviton</u>	<u>Hubbell</u>
Single pole PS20AC1-RPL	1221-7PR	HBL1221-PL7

- e. Provide remote control switches for mechanically held contactors arranged for 3-wire control, toggle type, momentary contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclose mechanism, and ivory handles

<u>Pass & Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1251-I	HBL1557-I	1285-I

- f. Provide remote control switches for magnetically held contactors arranged for 3-wire control, toggle type, maintained contact, single pole, 3-position with center off position, rated 20 amps at 120-277 volts AC only, with plaster ears, binding screws for side wiring, standard size composition cups which fully enclosed mechanism, and ivory handles.

<u>Pass and Seymour</u>	<u>Hubbell</u>	<u>Leviton</u>
1225-I	HBL 1385	1285-I

- g. Momentary Contact locking key type switch. 20A 120/277V center off. Key shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/32" spacing between forks and 5/16" width overall.

Arrow Hart

AH1995L w/ AH2000 key

- h. Momentary Contact switch low voltage 1 pole 3A 24VAC 3 position center off. Key for locking switch shall be District standardized vertically oriented, tamper resistant, forked key with two each 5/16" long forks, 5/31" spacing between forks and 5/16" width overall.

Pass and Seymour

Toggle 1081I Locking 1081KGRY w/#500 Key

2. Time Switches and Photoelectric Controls for existing construction; use section 26 0923 for new construction.

- a. Provide time switches with a 7-day, solid-state, electronic type capable of fully automatic or manual operation and housed in a sheet steel enclosure unless built into a panel or switchboard. Contacts rated for 25 amps resistive or inductive, each pole 240 VAC; 5 amps tungsten or 277 VAC pilot duty, each pole 240 VAC. Time switches to contain a non-volatile clock and non-volatile

memory with a built-in rechargeable super capacitor power carry-over system. Battery carryover is not acceptable. Provide a minimum of 15 on/off set points per week. Timing to be in one minute increments with a minimum on or off time of one minute. Time switch digital displays to indicate days of week, hours, and minutes. Display to contain a load status light to indicate when equipment is in operation. Time switches; Paragon Model EC7000 Series, Tork Model EW 101B series, Intermatic ET7000 series, or equal. Features required for application:.

- 1) Liquid crystal display panel.
- 2) Holiday scheduling: Up to 40 dates may be assigned special holiday schedules, up to one year in advance.
- 3) Automatically adjusts to and from daylight savings time and for leap year.
- 4) Contact ratings: 10 amp at 240 VAC.
- 5) Safety override switch for each circuit to either provide shut down of circuit or to override on.
- 6) Selective review: All or part of schedule shall be displayed at touch of a key.
- 7) Super Capacitor for power carry over system.
- 8) Supply voltage: 120 V.
- 9) 365-day advance scheduling.
- b. Photoelectric control: Shall be rated 2,000 watts, 120V with single pole, single throw, normally closed contact, enclosed in a die-cast aluminum gasketed enclosure with 1/2 inch conduit fitting, Tork series 2100, or equal.
3. Emergency Lighting Control Unit
 - a. The Emergency Lighting control Unit shall provide all required functionality to allow an standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
 - b. The emergency lighting control unit shall allow control of emergency lighting fixture in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.
 - c. The device shall have normally closed dry contacts capable of switching 10 amp emergency ballast loads at 120-277 VAC, 60 Hz, or 2 amp tungsten loads at 120 VAC, 60Hz.
 - d. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
 - e. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency)
 - f. The device's normal power input terminal shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
 - g. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.

- h. Device shall be WattStopper ELCU-100 Emergency Lighting Control Unit, LVS #EPC-PM Series, Lighting Control Design #GR 2001 series or Equal.
 - 4. School Main Entrance Intercom Station: See other Division 26 sections
 - a. Hands free single button telephone auto dialer with major applications access control. Dialer shall dial a primary telephone number. If the number is busy or does not answer, the unit shall hang up and dial up to nine backup numbers. When call is answered and the visitor is identified, the called individual depresses telephone button to gain access. Unit shall be provided with a black and white camera, lighted hood, and an interface for Proximity option. Unit shall be a stand alone entry host for various types of access cards, through a 26-bit Wiegand protocol interface card.
 - b. Trigon Electronics HF-2 or equal.
 - c. Trigon Electronics HF-2 Weather mounts or equal.

2.3 IDENTIFICATION AND SIGNS

A. Identification Plates:

1. Provide identification plates for the following unless otherwise specified, for switchboards, unit substations, motor control centers, control panels, push-button stations, time switches, contactors, motor starters, motor switches, panelboards, and terminal cabinets.
2. Identification plates shall be of plastic stock and shall adequately describe function, voltage and phase of identified equipment. Where identification plates are detailed or described on Drawings, inscription and size of letters shall be as indicated. For lighting and power panels, identification plates shall indicate panel designation, voltage, and phase of panel. For terminal cabinets, identification plates shall indicate system contained in terminal cabinet.
3. Identification plates shall be black-and-white nameplate stock of bakelite with characters cut through black exposing white. Plates shall be furnished with beveled edges and shall be securely fastened in place with No. 4 Phillips-head, cadmium-plated steel, self-tapping screws. Characters shall be 3/16 inch high, unless otherwise indicated.

B. Markings:

1. Install identification markings to surface-mounted starters, switches, disconnect switches, contactors, and other devices controlling motors and appliances. Provide abbreviations required along with an identifying number. Markings to be provided with locking type stencils using paint of a contrasting color. Figures shall be 3/8 inch high unless otherwise indicated. Dymo Industries Inc., self-sticking plastic labels, with embossed characters made with a typewriter may be installed instead of stencils and paint; p-touch self adhesive plastic, or Brother P-Touch self sticking laminated plastic labels may be installed.
2. High Voltage: High voltage switchboards, cabinets, boxes, and conduits exposed in accessible locations, including under buildings and in attics, are required to be marked "WARNING-HIGH VOLTAGE- ABOVE 600 VOLTS". Markings for switchboards shall consist of 18 gage steel, porcelain enamel sign of standard manufacture. Markings for boxes, cabinets, and conduits shall be by means of stenciling or printed self-adhesive markers, Westline Tel-A-Pipe, or equal. Provide letters of black on orange background and not less than 1-7/8 inches high. On

conduit runs, install markings at intervals not exceeding 10 feet in any individual area. Markings shall be installed after other painting Work is complete.

- C. Warning Signs:
 - 1. Provide a warning sign on outside of each door or gate to rooms or enclosures containing high voltage equipment. Signs required reading, "WARNING - HIGH VOLTAGE - KEEP OUT". Provide 2-inch high lettering.
 - 2. Provide a warning sign on each high-voltage non-load break disconnect and fused cutout (not oil filled). Signs required reading, "DO NOT OPEN UNDER LOAD". Provide 2 inch high lettering.
 - 3. Provide signs of standard manufacture, 18 gage steel, with porcelain enamel finish. Provide red lettering on a white background.

PART 3 - EXECUTION

3.1 INSTALLATION AND SUPPORT OF BOXES

- A. Install outlet boxes flush with finished surface of wall or ceiling. Install plumb and securely fastened to structure, independent of conduit. Except where otherwise indicated, provide factory-fabricated adjustable attachment bar hangers between studs to support outlet boxes. When installation is performed in fire rated walls, maintain the wall's rating integrity by means of approved fire stop methods.
- B. Outlet boxes installed in suspended or furred ceilings with steel runner or furring channels shall be supported, except where otherwise indicated, by a Unistrut P-4000 Tessco A1200HS-10, Cooper B-Line B22s-HG, or equal channel spanning main ceiling runner channels. Each box shall be supported from its channel by a 3/8 inch 16 threaded steel rod with a Unistrut P-4008, Fastenal #48604, Copper B-Line 78101140346 or equal nut and a Tomic No. 711-B Adapta-Stud, or equal. Rod shall be tightened to a jamb fit with channel and its nut. Box shall be locked to rod by means of a 1/2 inch locknut on stud and a 3/8 inch 16 hex nut locking stud to rod.
- C. Heights of outlets and equipment indicated on Drawings shall govern. In absence of such indications, following heights shall be maintained with heights measured to centerline unless otherwise noted:
 - 1. Install wall-mounted telephones, light switches, and other switches, 48 inches above finished floor. Refer to other Division 26, 27 and 28 Sections.
 - 2. Outlet boxes for fire alarm pull stations shall be mounted at 45 inches above finished floor to insure that the operating handle of the initiating device is no higher than 48 inches at finished floor. Under no circumstances shall operating handle of the device exceed 48 inches above finished floor regardless of indicated height on drawing.
 - 3. Wall mounted fire alarm strobe or horn/strobe devices shall be mounted such that the entire lens is not less than 80 inches above finished floor. If ceiling heights allow, wall mounted appliances shall have bottom of lens a minimum of 80 inches but not more than 96 inches to the top of lens.
 - 4. Install outdoor fire alarm audible devices or fire alarm sprinkler flow bells at least 10 feet but not more than 12 feet above finished floor to center. Provide STI or equal protective covers for devices when required.

5. Voice evacuation speakers mounted indoors shall be mounted in ceiling space or if mounted on wall shall not be less than 10 feet to center above finished floor.
6. Install clocks and speakers, in classrooms and offices, 8 feet above finished floor. Unless otherwise indicated.
7. In rooms other than places of assembly such as, but not limited to, multipurpose rooms, auditoriums, and libraries, clock outlets and speakers in classrooms and offices shall be mounted 8 feet above finished floors. Other assembly areas such as gymnasiums shall be mounted 10 to 12 feet above finished floor. Provide STI, or equal protective covers for clocks when required.
8. Install fire alarm strobe lights 80 inches to bottom of light above finished floor.
9. Install outside bells and yard light outlets 4 feet above second floor level for 2 or more story buildings, 12 inches below top plate level for one story buildings without covered porch or arcade, and 12 inches below covered porch and arcade ceilings.
10. Install desk telephones, power receptacle outlets, and data outlets 15 inches above finished floor.
11. Install panelboards and terminal cabinets 6 feet 6 inches from finish floor to top of cabinet.
12. Install television outlets at a height corresponding to location of television monitor, or a minimum of 15 inches above finished floor.
13. The use of extension boxes shall be limited to not more than 1 times the original depth of junction box.

3.2 COVER PLATES

- A. Provide a plate on each switch, plug, pilot light, data, interphone, public telephone, and television outlet, and on existing and reset outlets where so indicated or required. Plates shall be of stainless steel unless otherwise specified.
- B. Flush wiring device and signal system outlets indicated to be blank covered, shall be covered with blank stainless steel plates. Flush lighting outlets to be blanked shall be covered with Wiremold 5736 steel covers, or equal, painted to match surrounding finish. Provide stainless steel covers to blank indicated or required surface-mounted outlets.
- C. In the following cases, and at required locations. Switch and receptacle plates shall be engraved with the device(s), or fixtures being controlled, or as indicated:
 1. Three-gang and larger gang switches in locations other than classrooms.
 2. Lock switches.
 3. Pilot switches.
 4. Switches so located that operator cannot see fixtures, or items of equipment controlled while his hand is on the switch.
 5. Switches not in same room with fixtures or items of unit heaters, air curtains, fly fans, etcetera.
 6. Receptacles operating at other than 120 V shall be identified with the operating voltage.
 7. Switches operating on 277 V shall be identified with the operating voltage.
 8. Where indicated on Drawings.
- D. Designations shall be as indicated on Drawings or as specified by Architect.

- E. Standard GFI cover plates shall be Pass & Seymour 4600, Racor 5028-0, or equal. GFI cover plates shall be provided with a CAM lock mechanism with two keys or a padlock hasp that does not protrude through the face of the cover and will allow the shank of locks keyed Corbin No. 60 keys.

3.3 IDENTIFICATION OF CIRCUITS AND EQUIPMENT

- A. Provide descriptive nameplates or tags permanently attached to switchboards, motor control centers, transformers, panelboards, circuit breakers, disconnect switches, starters, pushbutton control stations and other apparatus installed for operation or control of circuits, appliances, fire alarm control panel(s), fire alarm annunciator(s), power supplies, terminal cabinets, energy management control units, and Information technology system backbone and distribution equipment points.
- B. Provide nameplates of engraved laminated plastic, or etched metal. Submit Shop Drawings denoting dimensions and format to Architect before installation. Fasten to equipment with escutcheon pins, rivets, self-tapping screws, or machine screws. Self-adhering or adhesive backed nameplates are not permitted.
- C. Fasten tags to feeder wiring in conduits at every point where runs are broken or terminated, including pull wires in empty conduits. Indicate circuit, phase, and function. Tag branch circuits in panel boards and motor control centers. Tags may be manufactured of pressure-sensitive plastic or embossed self-attached stainless steel or brass ribbon.
- D. Provide circuit identification cards and cardholders in all panel boards. Cardholders shall consist of metal frame retaining a clear plastic cover permanently attached to inside of panel door. List of circuits shall be typewritten on a card. Circuit description shall include name or number of circuit, area and connected load.
- E. Junction and pull boxes shall have covers stenciled with box number when indicated on Drawings, or circuit numbers according to panel schedules. Data shall be lettered in a conspicuous manner with a color contrasting with finish.
- F. Name shall be correctly engraved, with a legend indicating function or areas, when required by codes or indicated on Drawings.

3.4 PROTECTION

- A. Protect Work of this section until Substantial Completion.

3.5 CLEANUP

- A. Remove rubbish, debris, and waste materials and legally dispose of off Project site.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: **Copper or tinned-copper** wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, **1/4 inch** in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; **1-5/8 inches** wide and **1/16 inch** thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; **1-5/8 inches** wide and **1/16 inch** thick.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
 - 1. Pipe Connectors: Clamp type, sized for pipe.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

- A. Ground Rods: **Copper-clad; 3/4 inch by 10 feet, 5/8 by 96 inches** in diameter.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. **8** AWG and smaller, and stranded conductors for No. **6** AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare **tinned**-copper conductor, No. **2/0** AWG minimum. Bury at least **24 inches** below grade.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. 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.

3.2 EQUIPMENT GROUNDING

- A. 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 the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
 10. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- B. 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.
- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a **1/4-by-2-by-12-inch** grounding bus.
 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. **Metal** Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.3 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are **2 inches** 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. For grounding electrode system, install at least **three** rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least **12 inches** deep, with cover.
 - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
 - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
 - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. 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, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
 - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. 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.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections and prepare test reports:
 - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 - 2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells.
 - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any 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 according to IEEE 81.
- B. Report measured ground resistances that exceed the following values:
 - 1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: **10** ohms.
- C. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 26 05 33 - RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. See Division 26 Section "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks and manholes, and underground handholes, boxes, and utility construction.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

- A. Rigid Steel Conduit: ANSI C80.1.
- B. IMC: ANSI C80.6.
- C. EMT: ANSI C80.3.
- D. FMC: Zinc-coated steel.
- E. LFMC: Flexible steel conduit with PVC jacket.

- F. Fittings for Conduit Including all Types and Flexible and Liquidtight, EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
 - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886.
 - 2. Fittings for EMT: **Steel or die-cast, set-screw compression, set-screw or compression** type.

2.2 NONMETALLIC CONDUIT AND TUBING

- A. ENT: NEMA TC 13.
- B. RNC: NEMA TC 2, **Type EPC-40-PVC**, unless otherwise indicated.
- C. LFNC: UL 1660.
- D. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: UL 514B.

2.3 METAL WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper B-Line, Inc.
 - 2. Hoffman.
 - 3. Square D; Schneider Electric.
- C. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type **1, 12 and/or 3R**, unless otherwise indicated.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- E. Wireway Covers: **Hinged type, Screw-cover type, Flanged-and-gasketed type As indicated.**
- F. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Hoffman.
 - 2. Lamson & Sessions; Carlon Electrical Products.
- C. Description: PVC plastic, extruded and fabricated to size and shape indicated, with snap-on cover and mechanically coupled connections with plastic fasteners.
- D. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

2.5 SURFACE RACEWAYS

- A. Surface Metal Raceways: Galvanized steel with snap-on covers. **Manufacturer's standard enamel finish in color selected by Architect.**
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Thomas & Betts Corporation.
 - b. Walker Systems, Inc.; Wiremold Company (The).
 - c. Wiremold Company (The); Electrical Sales Division.
- B. Surface Nonmetallic Raceways: Two-piece construction, manufactured of rigid PVC with texture and color selected by Architect from **manufacturer's standard** colors.
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Butler Manufacturing Company; Walker Division.
 - b. Enduro Systems, Inc.; Composite Products Division.
 - c. Hubbell Incorporated; Wiring Device-Kellems Division.
 - d. Lamson & Sessions; Carlon Electrical Products.
 - e. Panduit Corp.
 - f. Walker Systems, Inc.; Wiremold Company (The).
 - g. Wiremold Company (The); Electrical Sales Division.

h. **<Insert manufacturer's name.>**

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, **aluminum**, Type FD, with gasketed cover.
- C. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- D. Metal Floor Boxes: **Cast or sheet metal, fully adjustable**, rectangular.
- E. Nonmetallic Floor Boxes: Nonadjustable, round.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, **cast aluminum** with gasketed cover.
- H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Plastic, **finished inside with radio-frequency-resistant paint**.
- I. Cabinets:
 - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
 - 1. Exposed Conduit: **RNC, Type EPC-40-PVC/RNC, Type EPC-80-PVC**.
 - 2. Concealed Conduit, Aboveground: **EMT**.
 - 3. Underground Conduit: **RNC, Type EPC-40-PVC**, direct buried.
 - 4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): **LFMC/LFNC**.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type **3R**.
- B. Comply with the following indoor applications, unless otherwise indicated:
 1. Exposed, Not Subject to Physical Damage: **EMT or RNC**.
 2. Exposed, Not Subject to Severe Physical Damage: **EMT**.
 3. Exposed and Subject to Severe Physical Damage: **Rigid steel conduit**. Includes raceways in the following locations:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 4. Concealed in Ceilings and Interior Walls and Partitions: **EMT or RNC, Type EPC-40-PVC**.
 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 6. Damp or Wet Locations: **Rigid steel conduit**.
 7. Raceways for Optical Fiber or Communications Cable: **EMT**.
 8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, **stainless steel / nonmetallic** in damp or wet locations.
- C. Minimum Raceway Size: **3/4-inch** trade size.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.

3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least **6 inches** away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

- G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
- H. Raceways Embedded in Slabs:
 - 1. Run conduit larger than **1-inch** trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
 - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 - 3. Change from ENT to RNC, Type EPC-40-PVC, rigid steel conduit, or IMC before rising above the floor.
- I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than **200-lb (90-kg)** tensile strength. Leave at least **12 inches (300 mm)** of slack at each end of pull wire.
- K. Raceways for Optical Fiber and Communications Cable: Install as follows:
 - 1. **3/4-Inch (19-mm)** Trade Size and Smaller: Install raceways in maximum lengths of **50 feet (15 m)**.
 - 2. **1-Inch (25-mm)** Trade Size and Larger: Install raceways in maximum lengths of **75 feet (23 m)**.
 - 3. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
- L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where otherwise required by NFPA 70.
- M. Expansion-Joint Fittings for RNC: Install in each run of aboveground conduit that is located where environmental temperature change may exceed **30 deg F**, and that has straight-run length that exceeds **25 feet**.
 - 1. Install expansion-joint fittings for each of the following locations, and provide type and quantity of fittings that accommodate temperature change listed for location:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: **125 deg F** temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: **155 deg F** temperature change.

- c. Indoor Spaces: Connected with the Outdoors without Physical Separation: **125 deg F** temperature change.
 - d. Attics: **135 deg F** temperature change.
- 2. 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.
- 3. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at the time of installation.
- N. Flexible Conduit Connections: Use maximum of **72 inches** of flexible conduit for **[recessed and semirecessed lighting fixtures]**, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- O. 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.
- P. Set metal floor boxes level and flush with finished floor surface.
- Q. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 31 Section "Earth Moving" for pipe less than **6 inches** in nominal diameter.
 - 2. Install backfill as specified in Division 31 Section "Earth Moving."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within **12 inches** of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through the floor, unless otherwise indicated. Encase elbows for stub-up ducts throughout the length of the elbow.
 - 5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with **3 inches** of concrete.
 - b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of **60 inches** from edge of equipment pad or

foundation. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately **12 inches** above direct-buried conduits, placing them **24 inches** o.c. Align planks along the width and along the centerline of conduit.

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

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

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
 - 1. **Black letters on an orange field.**
 - 2. Legend: Indicate voltage **and system or service type.**

- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, **2 inches** long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Write-On Tags: Polyester tag, **0.015 inch** thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
 - 1. **Black letters on an orange field.**
 - 2. Legend: Indicate voltage **and system or service type.**
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; **2 inches** wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Write-On Tags: Polyester tag, **0.015 inch** thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, **2 inches (50 mm)** long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than **3 mils** thick by **1 to 2 inches** wide.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- D. Write-On Tags: Polyester tag, **0.015 inch** thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.5 FLOOR MARKING TAPE

- A. **2-inch-** wide, **5-mil** pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical **and communications** utility lines.
 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
 1. Comply with ANSI Z535.1 through ANSI Z535.5.

C. Tag: **Type I:**

1. Pigmented polyolefin, bright-colored, **continuous-printed on one side with the inscription of the utility**, compounded for direct-burial service.
2. Thickness: **4 mils**.
3. Weight: **18.5 lb/1000 sq. ft.**
4. **3-Inch** Tensile According to ASTM D 882: **30 lbf**, and **2500 psi**.

D. Tag: **Type ID:**

1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, **continuous-printed on one side with the inscription of the utility**, compounded for direct-burial service.
2. Overall Thickness: **5 mils**.
3. Foil Core Thickness: **0.35 mil**.
4. Weight: **28 lb/1000 sq. ft.**
5. **3-Inch** Tensile According to ASTM D 882: **70 lbf**, and **4600 psi**.

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. **1/4-inch** grommets in corners for mounting.
3. Nominal size, **7 by 10 inches**.

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with **0.0396-inch** galvanized-steel backing; and with colors, legend, and size required for application.
2. **1/4-inch** grommets in corners for mounting.
3. Nominal size, **10 by 14 inches**.

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR **36 INCHES**."

2.8 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum **1/16 inch** thick for signs up to **20 sq. inches** and **1/8 inch** thick for larger sizes.
 - 1. Engraved legend with **black letters on white face**.
 - 2. Punched or drilled for mechanical fasteners.
 - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
- B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch**.
- C. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch**. Overlay shall provide a weatherproof and UV-resistant seal for label.

2.9 EQUIPMENT IDENTIFICATION LABELS

- A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be **3/8 inch**. Overlay shall provide a weatherproof and UV-resistant seal for label.
- B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be **3/8 inch**.
- C. Stenciled Legend: In nonfading, waterproof, **black** ink or paint. Minimum letter height shall be **1 inch**.

2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select 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 INSTALLATION

- A. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- B. Apply identification devices to surfaces that require finish after completing finish work.

- C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- D. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at **50-foot** maximum intervals in straight runs, and at **25-foot** maximum intervals in congested areas.
- F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at **6 to 8 inches** below finished grade. Use multiple tapes where width of multiple lines installed in a common trench **or concrete envelope** exceeds **16 inches** overall.
- G. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than **30A**, and **120V** to ground: Install labels at **10-foot** maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
 - 1. Emergency Power.
 - 2. Power.
 - 3. UPS.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
 - 1. Color-Coding for Phase **and Voltage Level** Identification, 600 V or Less: Use colors listed below for ungrounded **feeder and branch-circuit** conductors.
 - a. Color shall be factory applied **or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.**
 - b. Colors for 208/120-V Circuits:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - c. Colors for 480/277-V Circuits:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.

- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of **6 inches** from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach **marker tape** to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
 - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
 - 1. Limit use of underground-line warning tape to direct-buried cables.
 - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- H. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- I. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: **Baked-enamel warning signs.**
 - 1. Comply with 29 CFR 1910.145.
 - 2. Identify system voltage with black letters on an orange background.
 - 3. Apply to exterior of door, cover, or other access.
 - 4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
 - a. Power transfer switches.
 - b. Controls with external control power connections.
- J. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

- K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum **3/8-inch-** high letters for emergency instructions at equipment used for **power transfer**.
- L. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
 - 1. Labeling Instructions:
 - a. Indoor Equipment: **Engraved, laminated acrylic or melamine label.** Unless otherwise indicated, provide a 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 inches** high.
 - b. Outdoor Equipment: **Engraved, laminated acrylic or melamine label 4 inches high.**
 - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
 - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor photoelectric switches.
 - 3. Indoor occupancy sensors.
 - 4. Outdoor motion sensors.
 - 5. Lighting contactors.
 - 6. Emergency shunt relay.
- B. See Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and maintenance data.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:
 - 1. Area Lighting Research, Inc.; Tyco Electronics.
 - 2. Grasslin Controls Corporation; a GE Industrial Systems Company.
 - 3. Intermatic, Inc.
 - 4. Leviton Mfg. Company Inc.
 - 5. Lightolier Controls; a Genlyte Company.

6. Lithonia Lighting; Acuity Lighting Group, Inc.
7. Paragon Electric Co.; Invensys Climate Controls.
8. Square D; Schneider Electric.
9. TORK.
10. Touch-Plate, Inc.
11. Watt Stopper (The).

C. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.

1. Contact Configuration: **SPST**.
2. Contact Rating: **30-A inductive or resistive, 240-V ac**.
3. Program: 8 on-off set points on a 24-hour schedule **and an annual holiday schedule that overrides the weekly operation on holidays**.
4. Program: 2 on-off set points on a 24-hour schedule, allowing different set points for each day of the week **and an annual holiday schedule that overrides the weekly operation on holidays**.
5. Programs: 20 channels; each channel shall be individually programmable with 8 on-off set points on a 24-hour schedule.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program **on selected channels**.
7. Astronomic Time: **All** channels.
8. Battery Backup: For schedules and time clock.

D. Electromechanical-Dial Time Switches: Type complying with UL 917.

1. Contact Configuration: **SPST**.
2. Contact Rating: **30-A inductive or resistive, 240-V ac**.
3. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.
4. Astronomic time dial.
5. Eight-Day Program: Uniquely programmable for each weekday and holidays.
6. Skip-a-day mode.
7. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of **16** hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:

1. Area Lighting Research, Inc.; Tyco Electronics.
2. Grasslin Controls Corporation; a GE Industrial Systems Company.
3. Intermatic, Inc.
4. Lithonia Lighting; Acuity Lighting Group, Inc.
5. Novitas, Inc.
6. Paragon Electric Co.; Invensys Climate Controls.
7. Square D; Schneider Electric.
8. TORK.
9. Touch-Plate, Inc.
10. Watt Stopper (The).

- B. Description: Solid state, with **SPST** dry contacts rated for **1800-VA tungsten or 1000-VA inductive**, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
1. Light-Level Monitoring Range: **1.5 to 10 fc**, with an adjustment for turn-on and turn-off levels within that range, **and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.**
 2. Time Delay: 15-second minimum, to prevent false operation.
 3. Surge Protection: Metal-oxide varistor, complying with IEEE C62.41.1, IEEE C62.41.2, and IEEE 62.45 for Category A1 locations.
 4. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
- C. Description: Solid state, with **SPST** dry contacts rated for 1800 VA to operate connected load, relay, or contactor coils; complying with UL 773.
1. Light-Level Monitoring Range: **1.5 to 10 fc**, with an adjustment for turn-on and turn-off levels within that range.
 2. Time Delay: 30-second minimum, to prevent false operation.
 3. Lightning Arrester: Air-gap type.
 4. Mounting: Twist lock complying with IEEE C136.10, with base.

2.3 INDOOR OCCUPANCY SENSORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:
1. Hubbell Lighting.
 2. Leviton Mfg. Company Inc.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Novitas, Inc.
 5. RAB Lighting, Inc.
 6. Sensor Switch, Inc.
 7. TORK.
 8. Watt Stopper (The).
- D. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a **1/2-inch** knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Override the on function in case of sensor failure.
 7. Automatic Light-Level Sensor: Adjustable from **2 to 200 fc**; keep lighting off when selected lighting level is present.
- E. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
1. Detector Sensitivity: Detect occurrences of **6-inch-** minimum movement of any portion of a human body that presents a target of not less than **36 sq. in.**
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of **1000 sq. ft.** when mounted on a **96-inch-** high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within **90 feet** when mounted on a **10-foot-** high ceiling.

2.4 OUTDOOR MOTION SENSORS (PIR)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Leviton Mfg. Company Inc.
 2. Lightolier Controls; a Genlyte Company.
 3. Lithonia Lighting; Acuity Lighting Group, Inc.
 4. Square D; Schneider Electric.
 5. Watt Stopper (The).
 6. or equal and approved.
- B. Performance Requirements: Suitable for operation in ambient temperatures ranging from **minus 40 to plus 130 deg F**, rated as raintight according to UL 773A.
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 2. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
 - b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 3. Bypass Switch: Override the on function in case of sensor failure.

4. Automatic Light-Level Sensor: Adjustable from **1 to 20 fc**; keep lighting off during daylight hours.
- C. Detector Sensitivity: Detect occurrences of **6-inch-** minimum movement of any portion of a human body that presents a target of not less than **36 sq. in.**
- D. Detection Coverage: **Up to 35 feet, with a field of view of 90 degrees.**
- E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
- F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

2.5 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Allen-Bradley/Rockwell Automation.
 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 3. Eaton Electrical Inc.; Cutler-Hammer Products.
 4. GE Industrial Systems; Total Lighting Control.
 5. Hubbell Lighting.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Square D; Schneider Electric.
 8. Watt Stopper (The).
 9. or equal and approved.
- B. Description: Electrically operated and **electrically** held, combination type with **fusible switch**, complying with NEMA ICS 2 and UL 508.
 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as **indicated on Drawings**, matching the NEMA type specified for the enclosure.
- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
 1. Monitoring: On-off status.

2. Control: On-off operation.

2.6 EMERGENCY SHUNT RELAY

- A. Subject to compliance with requirements, provide products by one of the following:
 1. Lighting Control and Design, Inc.
- B. Basis-of-Design Product: Subject to compliance with requirements, provide **the product indicated on Drawings** or a comparable product by one of the following:
 1. Coil Rating: **120V**.

2.7 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "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** AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. **14** AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. 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 written instructions.
- B. When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to **two** visits to Project during other than normal occupancy hours for this purpose.

3.2 CONTACTOR INSTALLATION

- 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.

3.3 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be **1/2 inch**.

- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaries controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
 - 2. Operational Test: Verify operation of each lighting control device, and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

END OF SECTION

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
 - 2. Wall-box motion sensors.
 - 3. Snap switches and wall-box dimmers.
 - 4. Solid-state fan speed controls.
 - 5. Wall-switch and exterior occupancy sensors.
 - 6. Communications outlets.
- B. See Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; a division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand; Wiring Devices & Accessories (Pass & Seymour).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 5351 (single), 5352 (duplex).
 - b. Hubbell; HBL5351 (single), CR5352 (duplex).
 - c. Leviton; 5891 (single), 5352 (duplex).
 - d. Pass & Seymour; 5381 (single), 5352 (duplex).

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, **feed**-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; GF20.
 - b. Pass & Seymour; 2084.

2.4 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221 (single pole), 2222 (two pole), 2223 (three way), 2224 (four way).
 - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
 - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).

- d. Pass & Seymour; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
- C. Pilot Light Switches, 20 A:
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221PL for 120 V and 277 V.
 - b. Hubbell; HPL1221PL for 120 V and 277 V.
 - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
 - d. Pass & Seymour; PS20AC1-PLR for 120 V.
 - 3. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 2221L.
 - b. Hubbell; HBL1221L.
 - c. Leviton; 1221-2L.
 - d. Pass & Seymour; PS20AC1-L.
 - 3. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995.
 - b. Hubbell; HBL1557.
 - c. Leviton; 1257.
 - d. Pass & Seymour; 1251.
 - e.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
- 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 1995L.
 - b. Hubbell; HBL1557L.
 - c. Leviton; 1257L.
 - d. Pass & Seymour; 1251L.

2.5 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable **slider**; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
 - 1. 600 W; dimmers shall require no derating when ganged with other devices.
Illuminated when "OFF."
- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.6 FAN SPEED CONTROLS

- A. Modular, 120-V, full-wave, solid-state units with integral, quiet on-off switches and audible frequency and EMI/RFI filters. Comply with UL 1917.
 - 1. Continuously adjustable **slider, 1.5 A.**
 - 2. Three-speed adjustable **slider, 1.5 A.**

2.7 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 6111 for 120 V, 6117 for 277 V.
 - b. Hubbell; WS1277.
 - c. Leviton; ODS 10-ID.
 - d. Pass & Seymour; WS3000.
 - e. Watt Stopper (The); WS-200.
 - 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of **900 sq. ft.**
- B. Wall-Switch Sensors:
 - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 - 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; AT120 for 120 V, AT277 for 277 V.
 - b. Leviton; ODS 15-ID.

3. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of **900 sq. ft.**
- C. Long-Range Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP1600WRP.
 - b. Leviton; ODWWV-IRW.
 - c. Pass & Seymour; WA1001.
 - d. Watt Stopper (The); CX-100.
 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of **1200 sq. ft.**
- D. Long-Range Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATD1600WRP.
 - b. Leviton; ODW12-MRW.
 - c. Watt Stopper (The); DT-200.
 3. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of **1200 sq. ft.**
- E. Wide-Range Wall-Switch Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Hubbell; ATP120HBRP.
 - b. Leviton; ODWHB-IRW.
 - c. Pass & Seymour; HS1001.
 - d. Watt Stopper (The); CX-100-3.
 3. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of **1200 sq. ft.**
- F. Exterior Occupancy Sensors:
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Leviton; PS200-10.
 - b. Watt Stopper (The); EW-100-120.

3. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and **110-foot** detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

2.8 COMMUNICATIONS OUTLETS

A. Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3560-6.
 - b. Leviton; 40649.
3. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1 complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Cooper; 3562.
 - b. Leviton; 40595.
3. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

2.9 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: **Steel with white baked enamel, suitable for field painting**~~0.035-inch- thick, satin-finished stainless steel 0.04-inch- thick, brushed brass with factory polymer finish 0.05-inch- thick anodized aluminum 0.04-inch- thick steel with chrome-plated finish.~~
3. Material for Unfinished Spaces: **Galvanized steel.**
4. Material for Damp Locations: **Cast aluminum** with spring-loaded lift cover, and listed and labeled for use in "wet locations."

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant , **die-cast aluminum** with lockable cover.

2.10 FLOOR SERVICE FITTINGS

A. Type: Modular, **flush-type**, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

- C. Service Plate: **Rectangular, die-cast aluminum** with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: **Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.**

2.11 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
 - 1. Wiring Devices Connected to Normal Power System: **Ivory / White As selected by Architect**, unless otherwise indicated or required by NFPA 70 or device listing.
 - 2. Wiring Devices Connected to Emergency Power System: **Red.**
 - 3. TVSS Devices: Blue.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
 - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
 - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
 - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
 - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
 - 4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.

- b. Straighten conductors that remain and remove corrosion and foreign matter.
- c. Pigtailling existing conductors is permitted provided the outlet box is large enough.

D. Device Installation:

- 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
- 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
- 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
- 4. Connect devices to branch circuits using pigtails that are not less than **6 inches (152 mm)** in length.
- 5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
- 6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
- 7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
- 8. Tighten unused terminal screws on the device.
- 9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

- 1. Install ground pin of vertically mounted receptacles **up**, and on horizontally mounted receptacles to the **right**.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

- 1. Install dimmers within terms of their listing.
- 2. Verify that dimmers used for fan speed control are listed for that application.
- 3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 IDENTIFICATION

- A. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with **black**-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
 - 1. Test Instruments: Use instruments that comply with UL 1436.
 - 2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.

END OF SECTION

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.
5. Retrofit kits for fluorescent lighting fixtures.

B. Related Sections:

1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Division 26 Section "**Modular Dimming Controls**" for architectural dimming systems.
3. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.

1.2 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.
- C. Field quality-control reports.

1.3 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, **provide product indicated on Drawings.**

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- E. 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.
- F. Diffusers and Globes:
 - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 - a. Lens Thickness: At least **0.125 inch** minimum unless otherwise indicated.
 - b. UV stabilized.
 - 2. Glass: Annealed crystal glass unless otherwise indicated.
- G. Air-Handling LED Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23 Section "Diffusers, Registers, and Grilles."
 - 1. Air-Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
 - 2. Heat-Removal Units: Air path leads through lamp cavity.
 - 3. Combination Heat-Removal and Air-Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air-supply units.
 - 4. Dampers: Operable from outside fixture for control of return-air volume.
 - 5. Static Fixture: Air-supply slots are blanked off, and fixture appearance matches active units.

2.3 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
 - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
 - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.4 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. 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.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
7. Integral Time-Delay Relay: Holds unit on for fixed interval of [15] **<Insert period>** minutes when power is restored after an outage.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "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 fixture.
- C. Twin-Stem Hangers: Two, **1/2-inch** steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, **12 gage**.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, **12 gage**.

- F. Rod Hangers: **3/16-inch** minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Comply with NFPA 70 for minimum fixture supports.
- C. Suspended Lighting Fixture Support:
 - 1. Pendants and Rods: Where longer than **48 inches**, brace to limit swinging.
 - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
 - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- E. Adjust aimable lighting fixtures to provide required light intensities.
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. 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.

END OF SECTION

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior luminaires with lamps and ballasts.
 - 2. Luminaire-mounted photoelectric relays.
 - 3. Poles and accessories.

1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4-M.
- B. Live Load: Single load of **500 lbf**, distributed as stated in AASHTO LTS-4-M.
- C. Ice Load: Load of **3 lbf/sq. ft.**, applied as stated in AASHTO LTS-4-M Ice Load Map.
- D. Wind Load: Pressure of wind on pole and luminaire and banners and banner arms, calculated and applied as stated in AASHTO LTS-4-M.
 - 1. Basic wind speed for calculating wind load for poles exceeding **49.2 feet (15 m)** in height is **100 mph**.
 - a. Wind Importance Factor: **1.0**.
 - b. Minimum Design Life: **50 years**.
 - c. Velocity Conversion Factors: **1.0**.
 - 2. Basic wind speed for calculating wind load for poles **50 feet** high or less is **100 mph**.
 - a. Wind Importance Factor: **1.0**.
 - b. Minimum Design Life: **25 years**.
 - c. Velocity Conversion Factors: **1.0**.

1.3 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, and finishes.
- B. Shop Drawings: Anchor-bolt templates keyed to specific poles and certified by manufacturer.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, **available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.**

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES

- A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
 - 1. LER Tests Incandescent Fixtures: Where LER is specified, test according to NEMA LE 5A.
 - 2. LER Tests HID Fixtures: Where LER is specified, test according to NEMA LE 5B.
- B. Lateral Light Distribution Patterns: Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Corrosion-resistant aluminum unless otherwise indicated. Form and support to prevent warping and sagging.
- E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- F. 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. Designed to disconnect ballast when door opens.
- G. Exposed Hardware Material: Stainless steel.

- H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.
- J. 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.
- K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- L. 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.
- M. 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, "Solvent Cleaning," 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, "White Metal Blast Cleaning," or SSPC-SP 8, "Pickling."
 - 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: As selected from manufacturer's standard catalog of colors.
 - b. Color: Match Architect's sample of **manufacturer's standard** color.
 - c. Color: As selected by Architect from manufacturer's full range.
- N. 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; 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: Per Architect..
- O. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. 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 and ballast characteristics:
 - a. "USES ONLY" and include specific lamp type.
 - b. Lamp tube configuration (twin, quad, triple), base type, and nominal wattage for compact fluorescent luminaires.
 - c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
 - d. Start type (preheat, rapid start, instant start) compact fluorescent luminaires.
 - e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
 - f. CCT and CRI for all luminaires.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Comply with UL 773 or UL 773A.
- B. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at **1.5 to 3 fc** and off at **4.5 to 10 fc** with 15-second minimum time delay. **Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.**
 1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 2. Adjustable window slide for adjusting on-off set points.

2.4 FLUORESCENT BALLASTS AND LAMPS

- A. Ballasts for Low-Temperature Environments:
 1. Temperatures **0 Deg F** and Higher: **Electronic** type rated for **0 deg F** starting and operating temperature with indicated lamp types.
 2. Temperatures **Minus 20 Deg F** and Higher: Electromagnetic type designed for use with indicated lamp types.
- B. Ballast Characteristics:
 1. Power Factor: 90 percent, minimum.
 2. Sound Rating: Class A.
 3. Total Harmonic Distortion Rating: Less than **10** percent.

4. Electromagnetic Ballasts: Comply with ANSI C82.1, energy-saving, high power factor, Class P, automatic-reset thermal protection.
 5. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.
 6. Transient-Voltage Protection: Comply with IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
- C. Low-Temperature Lamp Capability: Rated for reliable starting and operation with ballast provided at temperatures **0 deg F** and higher.

2.5 BALLASTS FOR HID LAMPS

- A. Comply with ANSI C82.4 and UL 1029 and capable of open-circuit operation without reduction of average lamp life. Include the following features unless otherwise indicated:
1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
 2. Minimum Starting Temperature: **Minus 22 deg F**.
 3. Normal Ambient Operating Temperature: **104 deg F**.
 4. Ballast Fuses: One in each ungrounded power supply conductor. Voltage and current ratings as recommended by ballast manufacturer.
- B. High-Pressure Sodium Ballasts: Electromagnetic type with solid-state igniter/starter and capable of open-circuit operation without reduction of average lamp life. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

2.6 GENERAL REQUIREMENTS FOR POLES AND SUPPORT COMPONENTS

- A. Structural Characteristics: Comply with AASHTO LTS-4-M.
1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in "Structural Analysis Criteria for Pole Selection" Article.
 2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of **1.1** to obtain the equivalent projected area to be used in pole selection strength analysis.
- B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts unless otherwise indicated.
- C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.
1. Materials: Shall not cause galvanic action at contact points.
 2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication unless otherwise indicated.

3. Anchor-Bolt Template: Plywood or steel.
- D. Handhole: Oval-shaped, with minimum clear opening of **2-1/2 by 5 inches**, with cover secured by stainless-steel captive screws. **Provide on all, except wood poles.**
- E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 03 Section "Cast-in-Place Concrete."
- F. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.
- G. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4-M.

2.7 STEEL POLES

- A. Poles: Comply with ASTM A 500, Grade B, carbon steel with a minimum yield of **46,000 psig (317 MPa)**; one-piece construction up to **40 feet (12 m)** in height with access handhole in pole wall.
 1. Shape: **Square, straight.**
 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- B. Steel Mast Arms: **Single-arm** type, continuously welded to pole attachment plate. Material and finish same as pole.
- C. Brackets for Luminaires: Detachable, cantilever, without underbrace.
 1. Adapter fitting welded to pole, allowing the bracket to be bolted to the pole mounted adapter, then bolted together with **stainless / galvanized**-steel bolts.
 2. Cross Section: Tapered oval, with straight tubular end section to accommodate luminaire.
 3. Match pole material and finish.
- D. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- E. Steps: Fixed steel, with nonslip treads, positioned for **15-inch** vertical spacing, alternating on opposite sides of pole; first step at elevation **10 feet** above finished grade.
- F. Grounding and Bonding Lugs: Welded **1/2-inch** threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems,"

listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

- G. Cable Support Grip: Wire-mesh type with rotating attachment eye, sized for diameter of cable and rated for a minimum load equal to weight of supported cable times a 5.0 safety factor.
- H. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- I. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.
- J. Factory-Painted Finish: 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, "Solvent Cleaning," 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, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."
 - 2. Interior Surfaces of Pole: One coat of bituminous paint, or otherwise treat for equal corrosion protection.
 - 3. 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: **As selected by Architect from manufacturer's full range.**

2.8 ALUMINUM POLES

- A. Poles: Seamless, extruded structural tube complying with ASTM B 429/B 429M, Alloy 6063-T6 with access handhole in pole wall.
- B. Poles: **ASTM B 209**, 5052-H34 marine sheet alloy with access handhole in pole wall.
 - 1. Shape: **Square, straight.**
 - 2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.
- C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.
- D. Grounding and Bonding Lugs: Welded **1/2-inch** threaded lug, complying with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems," listed for attaching grounding and bonding conductors of type and size listed in that Section, and accessible through handhole.

- E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.
 - 1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
 - 2. Finish: Same as **pole luminaire**.
- F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.
- G. Aluminum Finish: 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; 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: **As selected by Architect from manufacturer's full range**.

2.9 POLE ACCESSORIES

- A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 26 Section "Wiring Devices" for ground-fault circuit-interrupter type.
 - 1. **Surface mounted, 12 inches** above finished grade.
 - 2. Nonmetallic polycarbonate plastic or reinforced fiberglass, weatherproof in use, cover, **to match pole**, that when mounted results in NEMA 250, **Type 3R** enclosure.
 - 3. With cord opening.
 - 4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.
- B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.
- C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.
- D. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept **ballast(s) indicated accessories**.

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION

- A. Install lamps in each luminaire.
- B. Fasten luminaire to indicated structural supports.
 - 1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. 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.**

3.2 POLE INSTALLATION

- A. Alignment: Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.
- B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features unless otherwise indicated on Drawings:
 - 1. Fire Hydrants and Storm Drainage Piping: **60 inches**.
 - 2. Water, Gas, Electric, Communication, and Sewer Lines: **10 feet**.
 - 3. Trees: **15 feet** from tree trunk.
- C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.
 - 1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
 - 2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
 - 3. Install base covers unless otherwise indicated.
 - 4. Use a short piece of **1/2-inch-** diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.
- E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Dig holes large enough to permit use of tampers in the full depth of hole.
 - 2. Backfill in **6-inch** layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.

- F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.
 - 1. Make holes **6 inches** in diameter larger than pole diameter.
 - 2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of **3000 psi** at 28 days, and finish in a dome above finished grade.
 - 3. Use a short piece of **1/2-inch-** diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
 - 4. Cure concrete a minimum of 72 hours before performing work on pole.
- G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of **6-inch-** wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with **pea gravel** to a level **1 inch** below top of concrete slab.
- H. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

- A. Align units for optimum directional alignment of light distribution.
- B. Install on concrete base with top **4 inches** above finished grade or surface at bollard 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 Division 03 Section "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

- A. Install on concrete base with top **4 inches** 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 Division 03 Section "Cast-in-Place Concrete."

3.5 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 Division 26 Section "Raceway and Boxes for Electrical Systems." In concrete foundations, wrap conduit with **0.010-inch-** thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

- A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole unless otherwise indicated.
 2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
1. Install grounding electrode for each pole.
 2. Install grounding conductor and conductor protector.
 3. Ground metallic components of pole accessories and foundations.

END OF SECTION

SECTION 26 56 17 - PARKING LOT AND SITE LED LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Lighting fixtures, including LED lamps arrangements, drivers, wiring, and lighting controls.
- B. Related Requirements:
 - 1. Division 01 - General Requirements.
 - 2. Section 26 0500: Common Work Results for Electrical.
 - 3. Section 26 0513: Basic Electrical Materials and Methods.
 - 4. Section 26 0526: Grounding and Bonding.
 - 5. Section 26 0519: Low-Voltage Wires.
 - 6. Section 26 0533: Raceways, Boxes, Fittings and Supports.
 - 7. Section 26 0923: Lighting Controls Systems.
 - 8. Section 26 2416: Panel boards and Signal Terminal Cabinets.
 - 9. Section 26 5000: Lighting.
 - 10. Section 26 5200: Emergency Power Systems.
 - 11. Section 31 2323: Excavating and Fill for Utilities
 - 12. Section 32 1313: Site Concrete Work.

1.2 REFERENCES

- A. Publications are referenced within the text by their basic designation only. The most current version shall apply.
- B. American National Standards Institute (ANSI):
 - 1. ANSI C82.SSL1 – SSL Drivers.
 - 2. ANSI C136.2 - American National Standard for Roadway and Area Lighting Equipment – Luminaire Voltage Classification.
 - 3. ANSI C136.3 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Attachments.
 - 4. ANSI C136.10 – American National Standard for Roadway Lighting Equipment – Locking-Type Photocontrol Devices and Mating Receptacle Physical and Electrical Interchangeability and Testing.
 - 5. ANSI C136.15 – American National Standard for Roadway and Area Lighting Equipment – Luminaire Field Identification.
 - 6. ANSI C136.25 – American National Standard for Roadway and Area Lighting Equipment – Ingress Protection (Resistance to Dust, Solid Objects and Moisture) for Luminaire Enclosures.
 - 7. ANSI C136.31 – American National Standard for Roadway Lighting Equipment – Luminaire Vibration.
- C. American Society for Testing and Materials International (ASTM):
 - 1. ASTM A36 – Standard Specification for Carbon Structural Steel.

2. ASTM A595 - Standard Specification for Steel Tubes, Low-Carbon or High-Strength Low-Alloy, Tapered for Structural Use.
 3. ASTM D1654 – Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments.
 4. ASTM G35 – Standard Practice for Determining the Susceptibility of Stainless Steels and Related Nickel-Chromium-Iron Alloys to Stress-Corrosion Cracking in Polythionic Acids.
- D. Federal Trade Commission (FTC):
1. Green Guides, 16 CFR Part 260, Guides for the Use of Environmental Marketing Claims.
- E. Illuminating Engineering Society of North America (IESNA):
1. IESNA DG-13 – Guide for the Selection of Photo controls for Outdoor Lighting Applications.
 2. IESNA LM-64 – Photometric Measurements of Parking Areas.
 3. IESNA LM-79 – IESNA Approved Method for the Electrical and Photometric Measurements of Solid-State Lighting Products.
 4. IESNA LM-80 – IESNA Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 5. IESNA TM-15 – Luminaire Classification System for Outdoor Luminaires
 6. IESNA TM-21 – Projecting Long Term Lumen Maintenance of LED Light Sources.
 7. IESNA RP-13 – Nomenclature and Definitions for Illuminating Engineering.
- F. National Electrical Manufacturers Association (NEMA):
1. ANSI/NEMA/ANSI C78.377 – American National Standard for the Chromaticity of Solid-State Lighting Products.
 2. NEMA WD 7 – NEMA Guide Publication: Occupancy Motion Sensors.
- G. California Building Code (CBC):
1. California Electrical Code (CEC).
- H. Next Generation Lighting Industry Alliance/Department of Energy:
1. LED Luminaire Lifetime: Recommendations for Testing and Reporting – 1st Edition.
- I. Underwriters Laboratories (UL):
1. UL – 1449 – Surge Protective Devices.

1.3 DEFINITIONS

- A. Lighting terminology used herein as defined in IESNA RP-16. See referenced documents for additional definitions.
- B. Exception: The term “driver” is used herein to broadly cover both drivers and power supplies, where applicable.
- C. Clarification: The term “LED light source(s)” is used herein in accordance with IES LM-80 to broadly cover LED package(s), module(s), and array(s).

- D. Support Assembly: Means a pole or other support structures, brackets, cross-arms, appurtenances, base, anchorage, and foundation.

1.4 SUBMITTALS

- A. List of Materials: Submit a complete list of materials proposed for this section.
- B. Shop Drawings: Provide detailed and dimensioned Shop Drawings indicating kind, weight and thickness of materials, method of fitting and fastening parts together, location and number of sockets, size of LED boards and drivers, and complete details of method of fitting suspension and fastening fixtures in place. Provide wiring diagrams for lighting control equipment. Drawings shall contain sufficient information to assemble and install equipment at the Project site without further instructions.

EDIT NOTE: Include paragraph C for projects to be designed by Contractor.

- C. Photometric calculations: Submit calculations with graphic of luminance levels of work and floor planes. Calculations shall comply with IESNA LM-64 recommendations.
- D. Performance Reports:
1. Luminaire photometric reports per IESNA LM-79 including: laboratory name, report number, date, luminaire catalog number, luminaire and light source specifications. Report shall contain lumen values in Backlight, Uplight, and Glare (BUG) zones per IESNA TM-15 and roadway type classifications luminous intensity, zonal lumen summary, and iso-footcandle diagrams, as well as documentation that specified standards and tests methods were followed.
- E. Certifications:
1. LM 79 report at T=0 and T=6000 hours with a summary table showing the percent lumen output change and percent input power change.
 2. Provide LM80 test results to demonstrate L70 life after 6000 hours of test.
 3. LM-80 test data for the LEDs at the three temperatures per LM-80. Provide extrapolation data using and exponential decay function to show the output at 50,000 hours. Provide the Ts value from the IESNA LM-79 and where the point fall in relation to the IESNA LM-80 extrapolated data. Interpolate between the LM 80 data for the Ts temperature.
 4. Provide safety certification and file number as required for the luminaire family that must be listed, labeled or identified per the California Electrical Code (CEC), Applicable testing bodies are determined by the US Occupational Safety Health administration (OSHA), and include ETL, UL, or another Nationally Recognized Testing Laboratory (NRTL).
 5. Report substantiating compliance with IESNA TM-21.
- F. Certified Statements:
1. Submit manufacturer's certified statement indicating that the manufacturer has been in the business of fabricating lighting fixtures for outdoor and general area illumination for a minimum of 10 years.
 2. Establish compliance with the California Lighting Efficiency and Toxics Reduction Act requirements for the manufacturer to have in place a collection and recycling

system of any end-of life general purpose light fixtures generated in the State of California.

3. Submit manufacturer's certified statement indicating that the manufacturer has local service with offices no more than 50 miles from Owner's central offices.
4. Certification of compliance that California Health and Safety Code requirements for products containing substances identified in the California Lighting Efficiency and Toxics Reduction Act shall not exceed the following allowed content in parts per million (ppm):
 - a. Lead content > 0.1% or 1000 ppm.
 - b. Mercury Content > 0.1% or 1000 ppm.
 - c. Cadmium Content > 0.01% or 100 ppm.
 - d. Hexavalent Chromium > 0.1% or 1000 ppm.
 - e. Polybrominated Biphenyls > 0.1% or 1000 ppm.
 - f. Polybrominated Biphenyls Ether > 0.1% or 1000 ppm.

- G. Installation Instructions: Submit manufacturer's written installation instructions for fixtures and accessories.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: 10 years in the fabrication of lighting fixtures.
- B. Listing and Labels: Light fixtures shall be Underwriters Laboratory (UL) or Nationally Recognized Testing Laboratory (NRTL) listed, and in compliance with applicable industry standards and codes. NRTL test laboratories shall be qualified by the DOE and listed in the DOE SSL website.
- C. Design of lighting fixtures, accessories, supports, and method of fixture installation shall comply with requirements for earthquake-resistant construction of the State of California.

1.6 WARRANTY

- A. Five years on-site replacement material, fixture finish and workmanship. On-site replacement includes transportation, removal, and installation of new products. Finish warranty shall include warranty against failure or substantial deterioration such as blistering, cracking, peeling, chalking or fading.
- B. Five years material replacement warranty for defective or non-starting LED source assemblies, drivers, and power supply units (PSU).
- C. LED source assemblies, drivers and power supplies that fail to maintain illuminance levels per Article 2.03.E shall be provided with an additional 10 years warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

EDIT NOTE: Select paragraph 1 or 2 as applicable to project. Delete unused paragraph.
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A. Lighting Fixtures.

1. The following fixtures are approved for installation in modernization projects:
 - a. General Electric – Evolve EAMM-EASM Series
 - b. Cree/Betalux – STR-LWY or ARE-EDG Series.
 - c. McGraw Edison/Cooper Lighting – Galleon Series.
 - d. Philips-Gardco – Pureform Series.
 - e. Equal with mast arm adapter will be acceptable.
2. The following fixtures are approved for installation in new construction projects:
 - a. General Electric – Evolve EAMM-EASM Series
 - b. Cree/Betalux – STR-LWY or ARE-EDG Series.
 - c. McGraw Edison/Cooper Lighting Galleon Series.
 - d. Philips/Gardco Pureform Series.
 - e. XGB3 Series by LSI
 - f. Equal.

B. Light Standards

EDIT NOTE: Revise paragraph A below if different height standards are required for complete replacements or new construction projects.

In retrofit projects where existing poles will remain, specify round tubular arm bracket mounting fittings.

1. Standards shall be 25 feet high, tapered galvanized steel, unless otherwise indicated on Drawings.
2. Aluminum poles are not acceptable.
3. Pole shaft shall conform to ASTM A595 Grade A and be 11 gage thickness, unless otherwise indicated on Drawings. Shaft shall be one piece construction with a full length longitudinal high frequency resistance weld.
4. The anchor base shall be constructed from structural quality hot rolled carbon steel plate conforming to ASTM A36.
5. Anchor bolts shall be fabricated from commercial quality hot rolled carbon steel bar with minimum yield strength of 55,000 PSI. Bolts shall have an L bend on one end and threaded on the opposite end. Anchor bolts shall be hot dipped galvanized with a minimum length of 12 inches on the threaded end. Four properly sized bolts furnished with two hex nuts, and flat washers, shall be provided for each pole. Contractor to obtain manufacturer required base bolt pattern prior to concrete installation.
6. A two piece base cover shall completely seal the entire base plate and anchorage and it shall be securely fastened.
7. Each pole shall have a three-inch by five-inch handle. A nut holder shall be provided near the handhole and shall include a ½ inch – 13 UNC HE by Head bolt and nut for grounding. The handhole shall be welded in the pole shaft and shall include a steel cover with attachment screws. The handhole shall be located 18 inches above the base of the pole.
8. Finish of pole and accessories shall be galvanized. Color shall be selected by Architect.
9. All structural fasteners shall be galvanized high strength carbon steel.
10. Poles shall be designed to withstand wind velocity of 80 MPH and 100 MPH gusts. Concrete base shall be a monolithic concrete pour when installed.

11. Standards shall be installed plumb and straight on concrete footings. Grout and dry-pack after leveling. Concrete, grout and drypack requirements and procedures are as specified in Division 2.
12. Provide in line fuse assembly in hand hole of each light standard with breakaway receptacle Bussmann HEY series, or equal. Fuse assembly shall easily disconnect power to light standard. Fuse type and rating shall be as required by each application.
13. Provide all required fixture mounting accessories, including round tubular arm brackets supplied with pole.
14. Standards shall be as manufactured by Gardco, Alcastco, Lytepole, or equal.

2.2 EQUIPMENT

- A. Fixtures shall meet the minimum performance requirements of efficiency and quality specified on Article 2.03.
- B. Fixtures of same type shall be of one manufacturer and shall meet the following requirements:
 1. Finish: Baked-on enamel or powder-coated.
 2. Luminaire Attachments in compliance to ANSI C136.3.
 3. Lens: Injection molded UV stabilized high impact acrylic in compliance to ANSI C136.31 requirements for luminaire vibration.
 4. Fixture Optics: Capable of full 90 degree horizontal cutoff on all distributions, and in compliance with the chromaticity of solid-state lighting products per ANSI/NEMA/ANDLG C78.377.
 5. Luminaire housing: Constructed of metal of sufficient thickness to meet or exceed the rated life of the luminaire LED's. Finish color as indicated in drawings. Powder-coated and rust resistant for the life of the luminaire in compliance with ASTM D1654 requirements.
 6. Driver shall be replaceable and mounted within luminaire housing.
 - a. Screws shall be stainless steel. Captive screws shall be provided for any components that require maintenance after installation.
 - b. Driver surge protection in compliance to UL 1449.
 - c. Approved drivers: Philips, General Electric, Cree, Osram, Nichia, or approved equal.
 7. No parts of the luminaire shall be constructed of polycarbonate, unless it is ultraviolet (UV) stabilized (lens discoloration shall be considered a failure under warranty).
 8. Luminaire shall be "Dark Sky" compliant.
 9. Luminaire shall have an option for individual LED's optical shield for house-side light control.
 - a. LEDs shall be Philips, Osram, Nichia, Illumitex, General Electric, Cree, or approved equal.
 10. Luminaire door shall remain securely and safely linked to luminaire body, through a hinge design, when in the door open "down" position during inspection or maintenance.
 11. Luminaire shall be capable of being operated by standard plug-in photoelectric cell, facing north, and shall not draw more than 1 watts of power in the off state. Photoelectric design shall comply with IESNA DG-13.

- a. Shorting cap shall be provided with luminaire.
 - 12. Luminaire shall have the option for motion sensor controls and 0-10V step dimming. Motion sensors shall comply with the requirements of NEMA standard WD 7 and photocell controllability per ANSI C136.10.
 - 13. Luminaire shall include a heat dissipating sink with no fans, pumps, or liquids.
 - a. Luminaire shall be designed so that debris buildup or bird droppings do not degrade heat dissipation performance.
 - b. Luminaire shall meet the requirements of ANSI C136.25 and C136.31 for resistance to dust, solid objects and moisture.
 - 14. Luminaire shall weigh no more than 40 pounds. 80% of the luminaire material by weight shall be recyclable at the end of life.
 - 15. Fixtures shall be UL or NRTL listed for wet locations.
 - 16. Fixtures shall be labeled in accordance with the Federal Trade Commission Green Guides, 16 CFR Part 260, Guide for the Use of Environmental Marketing Claims.
 - 17. Lighting fixtures shall be classified in accordance with IESNA TM-15.
- C. Luminaire shall have a manufacturer's stencil, or a permanent legible sticker, with the month and year of delivery.

2.3 PERFORMANCE REQUIREMENTS

- A. Luminaire must be subject to 100,000 cycles of 2 Gs at the resonant frequency of the luminaire (between 5 and 30 Hz) applied at the center of gravity per ANSI C136.31 without damage to the luminaire.
- B. Wiring cavity shall be field accessible for service or repairs.
- C. Coating shall be capable of surviving ASTM B117 salt environment for 500 hours minimum without blistering or peeling.
- D. Gloss retention shall be greater than 90% for the 500 hours exposure QUV test. Results shall conform to ASTM G35, 4 hours UV-B60°/4 hours condensation 50°C.
- E. Provide a minimum 6,000 hours of integral lamp operating data (not just LED data) and documented projection for 50,000 operating hours. Testing procedures and results documentation shall comply with the Department of Energy LED Luminaire Lifetime Recommendations for Testing and Reporting 1st Edition.
 - 1. LED shall comply with the requirements set forth in UL-1449.
- F. Lighting fixtures shall be rated for -20°C to +50°C.
- G. Color Rendering Index shall not be less than 70.
- H. Lighting fixtures shall have a minimum luminaire efficiency rating (LER) equal or greater than 75, and an Initial Lumen Efficacy (ILE) equal or greater than 70. Fixtures with lower LER and ILE shall not be accepted.
- I. The acceptable Correlated Color Temperature (CCT) shall be 4500 degrees K +/- 500 degrees K.

- J. Lumen Maintenance (LM) at 6000 Hrs must be greater or equal to 95%. Provide tests reports and photometric data.
- K. Projected Lumen Maintenance (LM) at 50000 hrs greater or equal to 90%.
- L. The Power Factor (PW) shall not be less than 0.90.
- M. The Total harmonic Distortion (THD) shall be less than 20%
- N. Fixtures shall operate on 120, 208, 240, 277, or 480 Volts in compliance with the requirements set forth in ANSI standard C136.15.
- O. Power supply shall have a Class A sound rating in compliance with the requirements set forth in ANSI standard C136.15.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Drivers and LED boards shall be permanently labeled with the day of installation with one inch high letters produced with a P-touch or similar permanent labeling system.
- B. Installations shall comply with CBC Seismic requirements, California Electrical code and applicable ordinances and industry standards.
- C. Standards shall be installed plumb and straight on concrete footings. Concrete requirements and procedures are as specified in Section 32 1313.
- D. Emergency light fixtures shall be labeled "Emergency Fixture" with one inch high letters produced with a P-touch or similar permanent labeling system.

3.2 TESTING

- A. Check and adjust fixtures for required illumination.
- B. Replace defective drivers and LED boards.
- C. Test and adjust lighting control equipment for proper operation.

3.3 SPARE PARTS

- A. Furnish ten percent spare drivers with a minimum of one spare LED board of each type.
- B. Furnish five percent spare motion detectors of each type with a minimum of one spare detector of each type.

3.4 HAZARDOUS WASTE DISPOSAL

- A. Hazardous waste disposals shall be handled and disposed of by licensed contractor.
- B. Store, remove, transport and dispose of hazardous materials in all accordance with state and federal regulations.
- C. Provide Owner with copy of manifest and certificate of destruction.

3.5 PROTECTION

- A. Protect the Work of this section until Substantial Completion.

3.6 CLEANUP

- A. Remove rubbish, debris, and waste materials from all areas of work each day.
- B. Clean fixture surfaces of dirt, cement, plaster and debris. Furnish cleansers compatible with material surfaces being cleaned.

END OF SECTION



WWII Monument
Torrance, CA

LUMINAIRE SCHEDULE and DATASHEETS

Initial Issue Date
December 15, 2025

Latest Revision Date
March 22, 2026

1		Revisions:
2	Bid Set	December 15, 2025
		March 22, 2026

WWII Monument

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GENERAL NOTES:

1. Luminaires shall have appropriate UL or other labels as required by local codes.
2. Luminaires shall include accessories for installation according to local and national codes.
3. Contractor shall verify the following prior to ordering luminaires:
 - a. locations and recess depths and any structural and other conflicts.
 - b. final voltages and ceiling trim compatibility.
 - c. ceilings more than 3/4" thick which limits trim compatibility.
 - d. luminaires in insulated ceilings, necessitating the need for insulated ceiling type housings.
4. Contractor shall provide approved fire-rated enclosures for luminaires located in a fire-rated ceiling.
5. Responsibility for emergency lighting, code compliance, and circuiting to meet code conformance remains with the Architect and Electrical Engineer as required by law.
6. Contractor shall submit luminaire substitutions prior to bid for review. Contractor shall supply a sample and/or photometric data if requested. If substitution is rejected, Contractor shall provide specified product.
7. Luminaire voltages to be determined by Project Electrical Engineer.
8. All luminaire sockets shall be labeled permanently, in the factory, with wattages indicated in "Lamp Specification" column, not maximum wattages.
9. Electrical Engineer may wire non-adjustable fixtures with emergency circuit(s) and power as needed.

LAST REVISIONS IN **BOLD**

WWII Monument							Initial Issue:	December 15, 2025
Torrance, CA							Latest Issue:	March 22, 2026
Type	Description	Luminaire Specification	Lamp Specification	Input Watts	Dimming Load Type	Luminaire Notes	Location	Rev No.
LB1	5" dia. 18' straight pole Finish: Standard finish	WE-EF Pole: AML-Z-18-50-188 Tenon: T3x4	N/A	N/A	N/A	Provide with pole top tenon to mount TA4 bracket.	Multiple	
LB1A	5" dia. 18' straight pole Finish: Standard finish	WE-EF Pole: AML-Z-18-50-188 Tenon: T3x4	N/A	N/A	N/A	Provide with pole top tenon to mount TA2 bracket.	Multiple	
LB1B	4" dia. 20' straight pole Finish: Standard finish	WE-EF AML-Z-20-60-156	N/A	N/A	N/A		Flag Pole	
LB2	LED pole-mounted adjustable area light Finish: Standard finish Optics: Diffuse Listings: UL, wet	BEGA Indirect Pole-Top Luminaire Aluminum Pole Fixture: B98019 Pole: B14THTE1	(Integral) Nominal lumens: 2776lm CCT: 3000K CRI: 90+	35.7W	0-10V		Garden	

WWII Monument						Initial Issue:	December 15, 2025	
Torrance, CA						Latest Issue:	March 22, 2026	
Type	Description	Luminaire Specification	Lamp Specification	Input Watts	Dimming Load Type	Luminaire Notes	Location	Rev No.
LD1	LED 4" dia. surface-mounted downlight Finish: Standard finish Optics: 55° Listings: UL, wet	BEGA Surface Mounted Downlight-Symmetric Very Wide Beam B24409-K3	(Integral) Nominal lumens: 961lm CCT: 3000K CRI: 80+	12W	0-10V		Restroom Building	
LD2	LED 4" dia. surface-mounted wall washer Finish: Standard finish Optics: Asymmetric Listings: UL, wet	BEGA Surface Mounted Downlight-Asymmetric Wall Washer B24426-K3	(Integral) Nominal lumens: 1359lm CCT: 3000K CRI: 90+	14W	0-10V		Restroom Building	
LG1	LED 3" wide 48" long linear ingrade wall grazer Finish: Standard finish Optics: Wallgraze Listings: ETL, wet, IK10	BOLD LIGHTING Billet Inground Wallgrazer Integral BOW-I-48-(finish)-H-U-B-B-G-9-30-0	(Integral) Nominal lumens: 1075lm/ft CCT: 3000K CRI:	15W/ft	0-10V		Monument	
LG1A	LED 3" wide 60" long linear ingrade wall grazer Finish: Standard finish Optics: Wallgraze Listings: ETL, wet, IK10	BOLD LIGHTING Billet Inground Wallgrazer Integral BOW-I-60-(finish)-H-U-B-B-G-9-30-0	(Integral) Nominal lumens: 1075lm/ft CCT: 3000K CRI:	15W/ft	0-10V		Monument	
LG1B	LED 3" wide 60" long linear ingrade wall grazer Finish: Standard finish Optics: Wallgraze Listings: ETL, wet, IK10	BOLD LIGHTING Billet Inground Wallgrazer Integral BOW-I-60-(finish)-H-U-B-B-G-9-30-0	(Integral) Nominal lumens: 1075lm/ft CCT: 3000K CRI:	15W/ft	0-10V		Monument	

WWII Monument						Initial Issue:	December 15, 2025	
Torrance, CA						Latest Issue:	March 22, 2026	
Type	Description	Luminaire Specification	Lamp Specification	Input Watts	Dimming Load Type	Luminaire Notes	Location	Rev No.
LG2	LED 2.4" dia. ingrade uplight Finish: Standard finish Optics: 115° Listings: UL, wet	TARGETTI Saturn Small Direct View LED Marker Light SAT-RP-DV-L1-30-24-(driver)-(installation)-(installation accessories)	(Remote) Nominal lumens: 48lm CCT: 3000K CRI: 90+	4W	0-10V		Monument	
LL1	LED spike mounted tree uplight Finish: Standard finish Optics: 40° Listings: ETL, wet	HEVI LITE HL-918 Fixture: HL-918-(finish)-L30-30-FL-120-277-(drivers)-GL-920 Mounting: GM-3-(finish)	(Integral) Nominal lumens: 720lm CCT: 3000K CRI: 90	5.4W	ELV	Fixture requires a remote driver which shall be concealed in accessible, well ventilated location.	Garden	
LL-F1	LED 5" dia. pole-mounted gobo projector Finish: Standard finish Optics: Adjustable gobo Listings: UL, wet	WE-EF FLC220 LED Gobo Projector Fixture: 139-2124 Mounting: TA4-L Mounting bracket, quad Gobo: Rosco Amorphous Pattern 77764	(Integral) Nominal lumens: 4900lm CCT: 3000K CRI: 80	42W	0-10V	Fixture is mounted to LB1 pole. Provide with TA4-L mounting; Manufacturer to confirm compatibility with the LB1 pole.	Garden	
LL-F2	LED 7.5" dia. pole-mounted floodlight Finish: Standard finish Optics: Symmetric, medium beam (M) Listings: UL, wet	WE-EF FLC220 LED Fixture: 139-2026 Mounting: TA4-L Mounting bracket, quad	(Integral) Nominal lumens: CCT: 3000K CRI: 80	29W	0-10V	Fixture is mounted to LB1 pole. Provide with TA4-L mounting; Manufacturer to confirm compatibility with the LB1 pole.	Garden	

WWII Monument Torrance, CA						Initial Issue:	December 15, 2025	
						Latest Issue:	March 22, 2026	
Type	Description	Luminaire Specification	Lamp Specification	Input Watts	Dimming Load Type	Luminaire Notes	Location	Rev No.
LL-F3	LED 7.5" dia. pole-mounted floodlight Finish: Standard finish Optics: Symmetric, wide beam (W) Listings: UL, wet	WE-EF FLC220 LED Fixture: 139-2024 Mounting: TA2-L Mounting bracket, double	(Integral) Nominal lumens: CCT: 3000K CRI: 80	29W	0-10V	Fixture is mounted to LB1A pole. Provide with TA2-L mounting; Manufacturer to confirm compatibility with the LB1A pole.	Garden	
LL-F4	LED 7.5" dia. pole-mounted floodlight Finish: Standard finish Optics: Symmetric, narrow beam (N) Listings: UL, wet	WE-EF FLC220 LED Fixture: 139-2028 Mounting: TS2-2/M16 Pole lamp, double	(Integral) Nominal lumens: CCT: 3000K CRI: 80	29W	0-10V	Fixture is mounted to LB1B pole. Provide with TS2-2/M16 mounting; Manufacturer to confirm compatibility with the LB1A pole.	Garden	

End of Lighting Fixture Schedule

AML-Z-ANC

Constant - Aluminum

we-ef

Straight round aluminum, anchored. Chromated pre-treatment with superior powdercoat finish in black RAL9004, grey metallic RAL9007, white RAL9016 or dark bronze RAL8019. Service door included, varies by product size.

The shaft is extruded from all new 6063 alloy aluminum tubing and heat treated to produce a T6 temper. Cast from A356 alloy aluminum, the anchor base is heat treated to produce a T6 condition and inserted into the anchor base casting. The two pieces are joined by a continuous circumferential weld at the outside top and inside bottom of the anchor base. The anchor bolts and nuts recess in the base casting, sitting flush, and are covered by four (4) tamper-resistant aluminum nut cover discs. Anchor bolts provided with pole.

Refer to Individual Spec sheets for allowable wind loading (Square Feet) - attached at the bottom.

Specify Product Code

-

Specify Pole Top or Tenon: 3"x3" Tenon (-T3x3), 3"x4" Tenon (-T3x4), 3"x4"

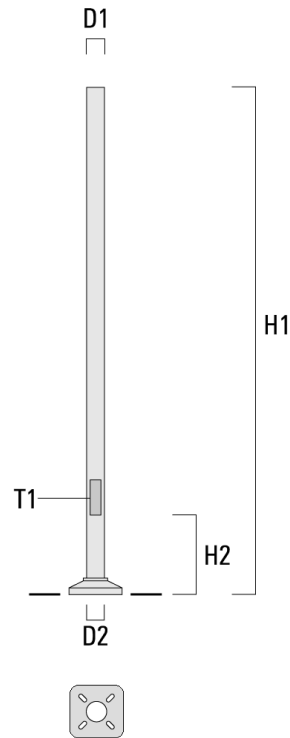
Tenon (-T3x5), or Pole Cap (-CAP)

-

Specify Finish Color: Black (-9004), Grey Metallic (-9007), White (-9016), or

Dark Bronze (-8019); (consult WE-EF color chart for others)

SAMPLE: 695-1140-T3x5-9004



Description	Part ID	D1	D2	H1	H2	Spigot	WallThickness	Weight
AML-Z-008-40-125	693-1220	4	4	8 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.13	19
AML-Z-10-40-125	693-1221	4	4	10 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.13	22
AML-Z-10-50-125	693-1222	5	5	10 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.13	27
AML-Z-12-40-125	693-1223	4	4	12 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.13	26
AML-Z-12-50-156	693-1224	5	5	12 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.16	38

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Project

Luminaire Type

WWII Monument

Torrance, CA

LB1

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AML-Z-ANC**Constant - Aluminum****we-ef**

AML-Z-14-50-156	693-1225	5	5	14 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.16	44
AML-Z-16-50-188	693-1230	5	5	16 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.19	58
AML-Z-16-60-156	693-1231	6	6	16 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.16	59
AML-Z-18-50-188	693-1232	5	5	18 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.19	65
AML-Z-18-60-188	693-1233	6	6	18 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.19	78
AML-Z-20-60-156	693-1234	6	6	20 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.16	73
AML-Z-20-60-188	693-1235	6	6	20 ft	23.62 in	Ø 3. x 3.15/ Ø 3. x 5.12/ Ø 3. x 7.87/ Ø 3.5 x 7.87/ Ø 4.25 x 7.87	0.19	86
AML-Z-08-60-156	693-0420	6	6	96	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.16	
AML-Z-10-60-156	693-0421	6	6	120	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.16	
AML-Z-12-60-156	693-0424	6	6	144	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.16	
AML-Z-14-60-156	693-0422	6	6	168	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.16	
AML-Z-16-60-156	693-0423	6	6	192	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.16	59
AML-Z-18-60-188	693-0425	6	6	216	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.19	78
AML-Z-20-60-188	693-0426	6	6	240	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.19	86
AML-Z-25-60-188	693-0427	6	6	300	23.62	Ø 3. x 3.15 + Ø 4. x 3.15	0.19	106

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Project

Luminaire Type

WWII Monument

Torrance, CA

LB1

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Application

Pole-top luminaire with adjustable, indirect light distribution. A symmetric distribution is produced when the top reflector is set in the horizontal position and becomes asymmetric when the reflector is adjusted from 0° to 30°.

Materials

Clear safety glass
Marine grade, copper free (≤0.3% copper content) A360.0 aluminum alloy
High temperature silicone gasket
Pure anodized aluminum reflector surface

NRTL listed to North American Standards, suitable for wet locations
Protection class IP 65

Weight: 33.0 lbs.

EPA (Effective projection area): 3.2 sq. ft.

Electrical

Operating voltage 120V or 277V AC
Minimum start temperature -10° C
LED module wattage 35.7 W
System wattage 39.7 W
Controllability 0-10V, TRIAC, and ELV dimmable
Color rendering index Ra > 90
Luminaire lumens 2776 lm
LED service life (L70) 60000 hrs

LED color temperature

- ☐ 4000K (K4)
- ☐ 3500K (K35)
- ☐ 3000K (K3)
- ☐ 2700K (K27)

BEGA can supply you with suitable LED replacement modules for up to 20 years after the purchase of LED luminaires - see website for details

Finish

All BEGA standard finishes are matte, textured powder coat with minimum 3 mil thickness. BEGA Unidure® finish provides superior fade protection in Black, Bronze, and Silver. BEGA standard White is a super durable polyester powder. Optionally available RAL, custom, and premium colors provided in polyester powder and/or liquid paint.

Available colors

- ☐ Black (BLK)
- ☐ Bronze (BRZ)
- ☐ Silver (SLV)
- ☐ White (WHT)
- ☐ RAL:
- ☐ CUS:

Type:

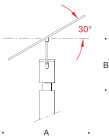
BEGA Product:

Project:

Modified:

Available options

- ☐ MGU Marine grade undercoat



Indirect pole-top luminaire · Adjustable · Cut-off optics			
	LED	A	B
B98019	35.7 W	31 1/2	21 1/4

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Project

WWII Monument

Torrance, CA

OCULUS LIGHT STUDIO

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Luminaire Type

LB2

Application

A round, tapered, aluminum pole with a hinged base. Useful for mounting pole-top luminaires, floodlights, banners, or other accessories. The hinged base allows for ease of access to pole-tops mounted to the pole. This pole is intended for regions with high wind speed or high EPA fixtures. Consult a licensed structural engineer when specifying. Poles must be unwrapped when delivered and should not be allowed to sit in their packaging. Poles specified without pole tops require internal approval before release.

Materials & Specifications

Extruded aluminum pole shaft
A356 aluminum alloy anchor base heat-treated to T6 temper
Anchor bolts conform to ASTM F1554 Grade 55 with L bend on one end and galvanized minimum 12" on threaded end
Anchor bolts provided with (2) hex nuts and (2) flat washers
2-piece aluminum cover provided with anchor base

Wall thickness: 0.188"

Structural weight: 43.0 lbs

Maximum Luminaire Weight: 50 lbs

Finish

All BEGA standard finishes are matte, textured powder coat with minimum 3 mil thickness. BEGA Unidure® finish provides superior fade protection in Black, Bronze, and Silver. BEGA standard White is a super durable polyester powder. Optionally available RAL, custom, and premium colors provided in polyester powder and/or liquid paint.

Available colors

- ☐ Black (BLK)
- ☐ Silver (SLV)
- ☐ RAL:
- ☐ Bronze (BRZ)
- ☐ White (WHT)
- ☐ CUS:

Type:

BEGA Pole:

Location:

Quote or Sales Order:

Date:

Specifier:

Representative:

BEGA Luminaire:

Total Mounted EPA:

Total Mounted Weight:

Available options

- ☐ CUS
- ☐ GFCI
- ☐ MGU
- ☐ RAL
- Custom finish
- GFCI with standard cover (Orientation: 180°;
Height: 18" A.F.G)
- Marine grade undercoat
- RAL Classic, matte finish

Available accessories

- ☐ B19615
- ☐ BDPC-1
- ☐ BDPC-2
- ☐ BDPC-3
- Square base cover
- Decorative pole base cover
- Decorative pole base cover
- Decorative pole base cover

See individual accessory spec sheet for details.

Included (available for pre-shipment)

- ☐ B14RHTE1-AB Anchorage kit



Aluminum pole - Round Hinged Tapered High EPA								
	A	B*	C	D	E			
B14RHTE1	3"	14'	12 ^{5/8} "	5"	3"			
Pole wind load rating								
MPH	85	90	100	110	120	130	140	150
EPA**	13.8	12.1	9.5	7.6	6.2	5.1	4.2	3.6

*Height is rounded to the nearest foot, for precise measurements see submittal drawing.

**Data above assumes grade level installation and a maximum luminaire weight of 50 lbs.

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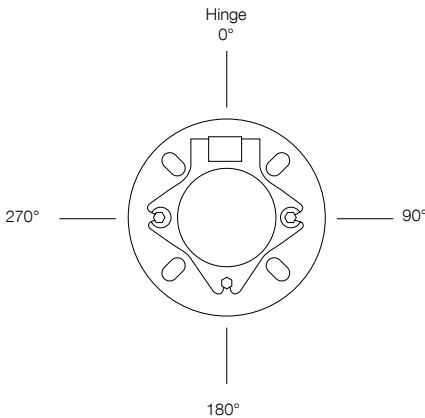
Pole Base Cover Reference

See page 01 for compatibility

BEGA

Included	Decorative (optional)	Square (optional)
 Round	 DPC-1  DPC-2  DPC-3	 B19614  B19615  B19605

Location Diagram



Options

Power Receptacle

GFCI covers provided are intended for portable tools or other portable equipment connected to the outlet when attended.
Wet location listed when cover is closed.

- ☐ GFCI at default location
Orientation: 180°; Height: 18" A.F.G.
☐ In-user cover

Modifications

Any changes or additions to BEGA North America's standard pole offering that are not listed as accessories or options are considered modifications. Should a modification be required, the below section is intended to help streamline the process during the initial design and specification. All modifications will need to be quoted and approved by BEGA North America prior to order placement.

Modified Pole Height:

Power Receptacle - Nonstandard Location

- ☐ GFCI at custom location
Orientation:
Height (min. 18" A.F.G.):
☐ In-user cover

Vibration Dampener

- ☐ Vibration dampener
Solution provided will vary depending on needs.

Handhole

Handhole must be 18" from GFCI

- ☐ Handhole at default location
Orientation: 0°; Height: 18" A.F.G.
☐ Handhole at custom location
Orientation:
Height:

Still not finding what you need?

Additional modifications may be available. Please contact your local BEGA representative to learn more about our modification capabilities.

Note: Accessories, options, and modifications may require additional lead-time and increase cost. All details must be quoted and approved by BEGA North America prior to order placement.

Disclaimer

BEGA North America warrants the specific anchor bolts and pole combination according to the product number(s) and description(s) indicated on the submittal sheet. Structural changes to the pole requested by the customer, including changes to pole length, may affect the compatibility of the anchor bolts and corresponding poles. BEGA North America is not responsible for the incompatibility of the anchor bolts and poles resulting from such structural changes without review by the BEGA North America engineering department. This includes, but is not limited to, any labor charges, charges for replacement materials and shipping. For safety reasons, do not mount more than 50 lbs. to hinged poles and more than 62 lbs. to fixed poles. Pole capacities are based upon the provisions of AASHTO 2013 (LTS-6) and assume a max vertical eccentricity to the fixture of 2'-0" above the pole top. Adequate drainage must be provided in concrete foundation or grout. Do not seal the base of the pole. Due to structural reasons, do not install pole without fixture or other appropriate weight on the top. BEGA North America is not responsible for ensuring local code compliance of anchor bolts, pole or pole top, including but not limited to wind speed or ice loading calculations.

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Project

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Torrance, CA

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Luminaire Type

LB2

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www.oculuslightstudio.com

Application

Compact ceiling mounted downlights designed for down lighting atriums, canopies, passages and other interior and exterior locations.

Materials

Clear safety glass
Marine grade, copper free ($\leq 0.3\%$ copper content) A360.0 aluminum alloy
Silicone applied robotically to casting, plasma treated for increased adhesion
Pure anodized aluminum reflector surface
Silicone optic with excellent high temperature and UV stability
BEGA Hybrid Optics®

NRTL listed to North American Standards, suitable for wet locations
Protection class IP 65

Weight: 1.65 lbs.

Electrical

Operating voltage	120-277V AC
Minimum start temperature	-30° C
LED module wattage	8.0W
System wattage	12.0W
Controllability	0-10V dimmable
Color rendering index	Ra > 80
Luminaire lumens	961 lm
LED service life (L70)	60000 hrs

LED color temperature

4000K (K4)
3500K (K35)
3000K (K3)
2700K (K27)

BEGA can supply you with suitable LED replacement modules for up to 20 years after the purchase of LED luminaires - see website for details

Finish

All BEGA standard finishes are matte, textured powder coat with minimum 3 mil thickness. BEGA Unidure® finish provides superior fade protection in Black, Bronze, and Silver. BEGA standard White is a super durable polyester powder. Optionally available RAL and custom color finishes provided in either polyester powder or liquid paint.

Available colors

Black (BLK)	Bronze (BRZ)
Silver (SLV)	White (WHT)
RAL:	CUS:

Type:

BEGA Product:

Project:

Modified:

Available options

CUS	Custom finish
FSC	Fusing
MGU	Marine grade undercoat
RAL	RAL finish

Included (available for pre-shipment)

B19538	Small opening wiring box
--------	--------------------------



Surface mounted downlight · Symmetric very wide beam

	LED	□	A	B
B24409	8.0W	55°	3 ⁷ / ₈	4 ³ / ₈

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Luminaire Type

LD1

Application

Compact ceiling mounted downlights with an asymmetric distribution designed for the illumination of walls in corridors and other interior and exterior locations.

Materials

Clear safety glass
Marine grade, copper free (≤0.3% copper content) A360.0 aluminum alloy
Silicone applied robotically to casting, plasma treated for increased adhesion
Pure anodized aluminum reflector surface
Silicone optic with excellent high temperature and UV stability

NRTL listed to North American Standards, suitable for wet locations
Protection class IP 65

Weight: 3.1 lbs.

Electrical

Operating voltage	120-277V AC
Minimum start temperature	-30° C
LED module wattage	11.5 W
System wattage	14.0 W
Controllability	0-10V, TRIAC, and ELV dimmable
Color rendering index	Ra > 90
Luminaire lumens	1359 lm
LED service life (L70)	60000 hrs

LED color temperature

4000K (K4)
3500K (K35)
3000K (K3)
2700K (K27)

BEGA can supply you with suitable LED replacement modules for up to 20 years after the purchase of LED luminaires - see website for details

Finish

All BEGA standard finishes are matte, textured powder coat with minimum 3 mil thickness. BEGA Unidure® finish provides superior fade protection in Black, Bronze, and Silver. BEGA standard White is a super durable polyester powder. Optionally available RAL and custom color finishes provided in either polyester powder or liquid paint.

Available colors

Black (BLK)	Bronze (BRZ)
Silver (SLV)	White (WHT)
RAL:	CUS:

Type:

BEGA Product:

Project:

Modified:

Available options

CUS	Custom finish
FSC	Fusing
MGU	Marine grade undercoat
RAL	RAL finish



Surface mounted downlight · Asymmetric wall washer

	LED	A	B
B24426	11.5W	5 7/8	5 1/4



BEGA 1000 BEGA Way, Carpinteria, CA 93013 (805)684-0533 info@bega-us.com

Due to the dynamic nature of lighting products and the associated technologies, luminaire data on this sheet is subject to change at the discretion of BEGA North America. For the most current technical data, please refer to bega-us.com
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Project

WWII Monument

Torrance, CA

OCULUS LIGHT STUDIO

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Luminaire Type

LD2

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BILLET

WALLGRAZER INTEGRAL - WET LOCATION

bold
lighting



The Billet family of products allows you to achieve uniformity throughout indoor and outdoor spaces while maintaining the same optical performance, light consistency, and overall aesthetics.

The Billet Wallgrazer delivers unmatched vertical illumination with virtually zero glare. The Billet confidently delivers a flawless light distribution and a beautifully finished product.

CONSTRUCTION

Product Type : Linear
Body Material : Extruded Aluminum
Body Finish : Black / Grey / White
Custom RAL
IP Rating : IP67 Inground
IP66 Ceiling Recessed
IK Rating : IK10
Drive Over Rating : Billet Inground is designed to bear static loads up to 2500 lbs. from vehicles with pneumatic tires. This product is not intended to be used for traffic lanes. Chicago plenum rated

INSTALLATION

Environment : Wet Location
Mounting : Inground / Ceiling Recessed (Trim & Trimless) / Wall Recessed (Trim & Trimless) / Surface Mounted / Wall Mounted / Pendant

OPTICS

Optical Distribution : Wallgraze

LIGHT SOURCE

Direct Light Source : Hi-power LEDs
Luminous Output : from 385lm/ft. to 1485lm/ft. (Delivered)
Light Source CCT : 2700K / 3000K / 3500K 4000K / Tunable White (2700K-5000K)
Dim-to-Warm (3000K-1800K) / RGBW
Color Rendering Index : Ra90
Lifetime : L80 B10 @ 70,000 Hrs

ELECTRICAL

Input Voltage : 120V / UNV 120-277V - 50Hz/60Hz
Load : 5W/ft. to 20W/ft.
Output Type : Constant Current
Driver Type : Integral
Dimming : 0-10V / DALI / ELV / DMX / Lutron Hi-Lume
Code Compliance : ETL / CSA / CE

Series	Mounting	Nominal Length ¹
BOW	R Recessed with Trim	12 12"
	T Recessed Trimless*	24 24"
	S Surface Mounted	36 36"
	P Pendant	48 48"
	I Inground*	60 60"
	W Wall Mounted	XX Custom in
	*For Inground "I" and Recessed Trimless "T" mountings, the housings will show on the price quote and order as a separate item to allow us to ship them ahead of the fixtures if required by the contractor. For custom lengths and shapes, consult factory. For exact lengths refer to dimensions table.	

Code example: **BOW**-P12W-L1B-W-G927-0

Body Finish	Output	Voltage	Dimming	Baffles	Beam Angle	CRI	Color Temp	Emergency
B Black	L² 440lm/ft (5W)	1 120V	A No Dimming	W Flat White	G Grazer	9 +90	27 2700K	0 No
G Grey	M² 765lm/ft (10W)	U⁶ Universal 120 to 277V	B 0-10V to 1%	B Flat Black			30 3000K	
W White	H² 1075lm/ft (15W)		D DALI to 1%	N Black Nickel			35 3500K	
X Custom RAL	V² 1390lm/ft (20W)		E ELV Dimming	C Specular Chrome			40 4000K	
	D³ 420lm/ft (9W)		F DMX	E Diffuse Gold			WD 3000K-1800K	
	W² 1195lm/ft (18W)		G⁷ LUTRON	X Custom			TW 2700K-5000K	
	U⁴ 650lm/ft (10W)						CC⁸ RGBW	
	A⁴ 1195lm/ft (20W)							
	C⁵ 1005lm/ft (20W)							

Notes:

- ¹ 6" length increments available as a modification.
- ² Denotes output at 3000K, unless otherwise noted.
- ³ Denotes output specific to Dim-to-Warm at 3000K.
- ⁴ Denotes output specific to Tunable White at full on.
- ⁵ Denotes RGBW (IC) output with all colors at full power.
- ⁶ Not applicable for ELV dimming.
- ⁷ Hi-lume, Vive, and Athena compatible.
- ⁸ Only available with DMX dimming.

Consult factory for lead-times.
Consult factory for systems using multiple optics and mounting configurations.



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Torrance, CA

OCULUS LIGHT STUDIO

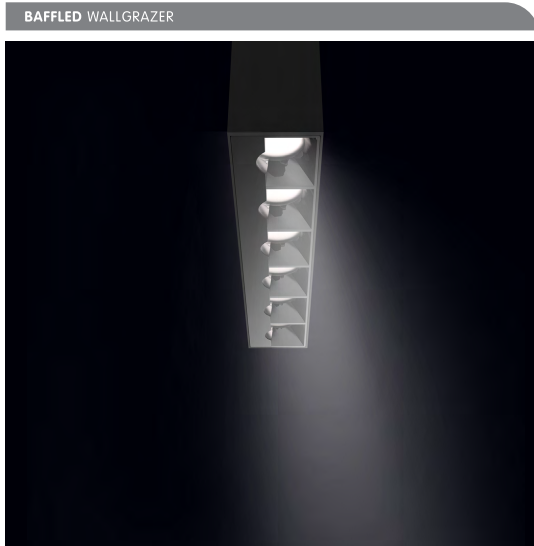
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Luminaire Type

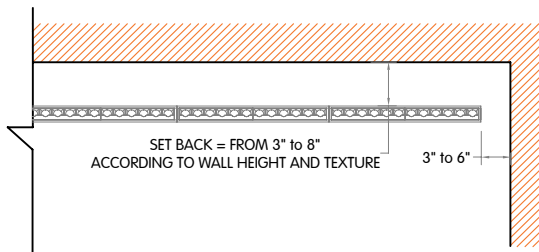
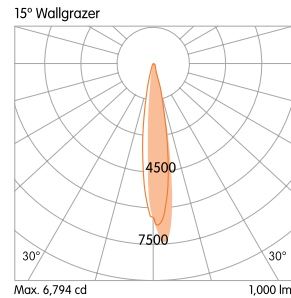
LG1 SERIES

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OPTICAL FLEXIBILITY



Billet wallgrazer delivers maximum performance for emphasizing textured and rough vertical surfaces. The standard output illuminates walls up to 14'-0" with outstanding transversal and longitudinal glare control.



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Luminaire Type

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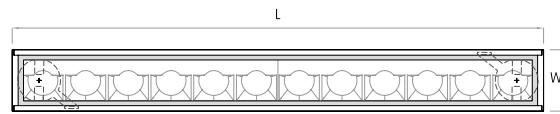
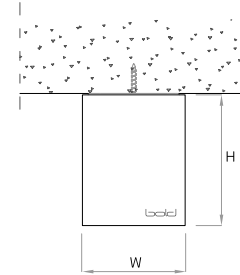
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MOUNTING FLEXIBILITY

SURFACE MOUNTED



Actual
 $L = 24\frac{1}{2}" \mid 36\frac{5}{16}" \mid 48\frac{1}{8}" \mid 59\frac{5}{16}"$
 Continuous runs
 $W = 2\frac{13}{16}"$
 $H = 3\frac{9}{16}"$

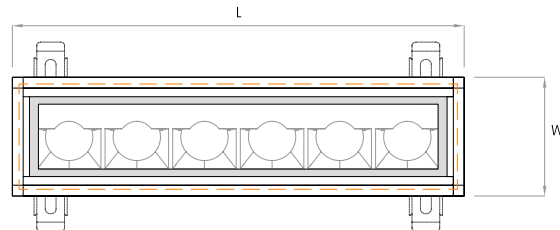
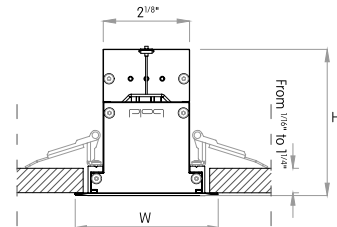


RECESSED WITH TRIM



$(L = 13\frac{1}{16}" \times W = 13\frac{1}{16}")$

Actual
 $L = 13\frac{3}{16}" \mid 25" \mid 36\frac{13}{16}" \mid$
 $48\frac{5}{8}" \mid 60\frac{7}{16}" \mid$
 Continuous runs
 $W = 3\frac{7}{16}"$
 $H = 3\frac{9}{16}"$



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Luminaire Type

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MOUNTING FLEXIBILITY

RECESSED TRIMLESS



$$\left(L + \frac{1}{16}'' \times W + \frac{1}{16}'' \right)$$

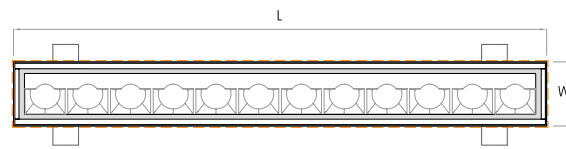
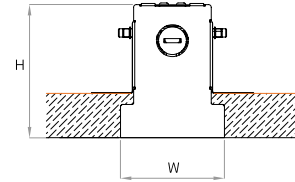
Actual

L = 24⁵/₈" | 36³/₈" | 48¹/₄" | 60"

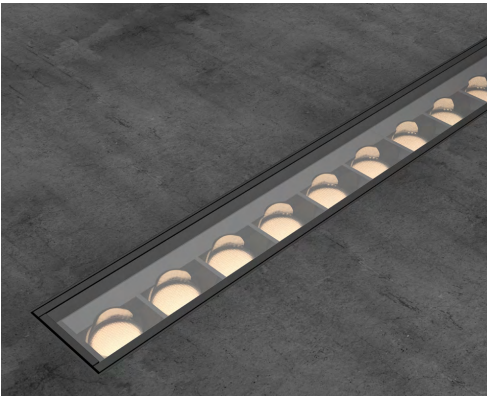
Continuous runs

W = 2¹⁵/₁₆"

H = 3¹³/₁₆"



INGROUND



Actual

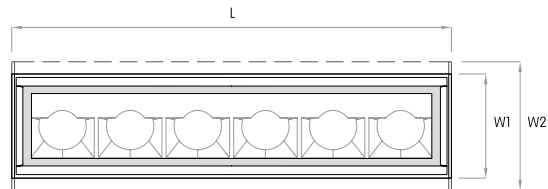
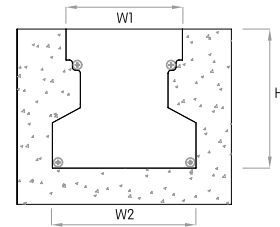
L = 12¹³/₁₆" | 24⁵/₈" | 36⁷/₁₆" |

48¹/₄" | 60"

Continuous runs

W1 = 3" | W2 = 3³/₄"

H = 3⁵/₈"



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Luminaire Type

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MOUNTING FLEXIBILITY

PENDANT



Actual

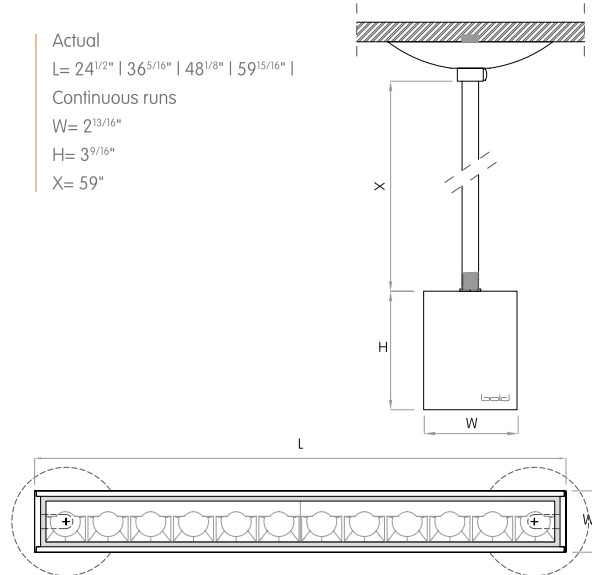
L= 24¹/₂" | 36⁵/₁₆" | 48¹/₈" | 59¹⁵/₁₆" |

Continuous runs

W= 2¹³/₁₆"

H= 3⁹/₁₆"

X= 59"



WALL MOUNTED



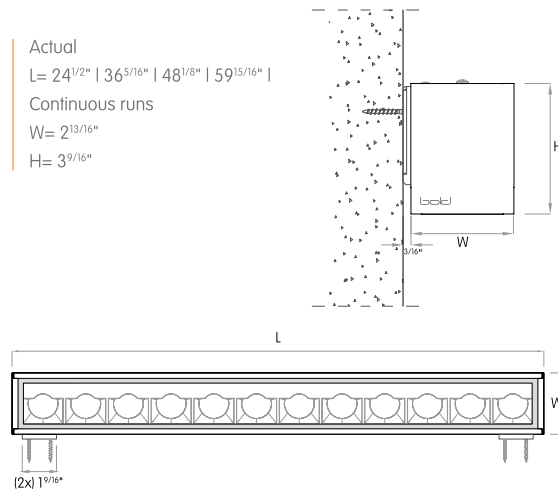
Actual

L= 24¹/₂" | 36⁵/₁₆" | 48¹/₈" | 59¹⁵/₁₆" |

Continuous runs

W= 2¹³/₁₆"

H= 3⁹/₁₆"



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Luminaire Type

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DELIVERED LUMEN OUTPUT
Per Linear Foot

Output		Watts		CRI +90			
STATIC-WHITE		2700K	3000K	3500K	4000K		
L	5W	385 lm	440 lm	420 lm	425 lm		
M	10W	725 lm	765 lm	780 lm	795 lm		
H	15W	1050 lm	1075 lm	1135 lm	1160 lm		
V	20W	1350 lm	1390 lm	1460 lm	1485 lm		
DIM-TO-WARM 3000K-1800K		3000K					
D	9W	420 lm					
W	18W	1195 lm					
TUNABLE WHITE 2700K-5000K		2700K	5000K				
U	10W	650 lm	650 lm				
A	20W	1195 lm	1195 lm				
RGBW		R	G	B	W		
TOTAL	20W	615 lm	1005 lm	155 lm	955 lm		

DIMENSIONS TABLE

					12"		24"		36"		48"		60"	
	Height		Width		Actual Length									
Surface Mounted	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
	91	3 9/16	72	2 13/16			622	24 1/2	922	36 5/16	1222	48 1/8	1522	59 15/16
Recessed with Trim	91	3 9/16	88	3 7/16	335	13 3/16	634	25	934	36 13/16	1234	48 5/8	1534	60 7/16
Recessed Trimless	97	3 13/16	75	2 15/16			624	24 5/8	924	36 3/8	1224	48 1/4	1524	60
Pendant	91	3 9/16	72	2 13/16			622	24 1/2	922	36 5/16	1222	48 1/8	1522	59 15/16
Inground (with housing)	92	3 5/8	95	3 3/4	325	12 13/16	625	24 5/8	925	36 7/16	1225	48 1/4	1525	60
Wall Mounted	91	3 9/16	72	2 13/16			622	24 1/2	922	36 5/16	1222	48 1/8	1522	59 15/16



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OCULUS LIGHT STUDIO

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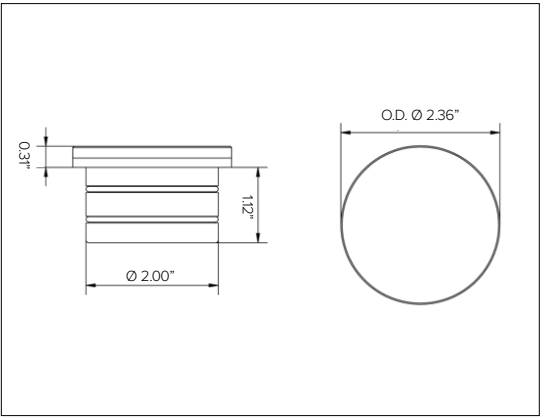
Luminaire Type

LG1 SERIES

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SATURN

Small Direct View LED Marker Light



CONCEPT

Small direct view recessed ingrade / wall marker light.

FIXTURE MECHANICAL CHARACTERISTICS

Housing	Ø 2.36" Dia.
Materials	Milled anodized aluminum marine grade cataphoresis ⁴ body. Opal white .35" thick polymethyl methacrylate lens.
Power Connection	Pre-cabled with 2ft direct burial 18ga 2 conductor cable for connection to remote power supply.
Mounting	Recessed mounting with installation sleeve (required).
Installation	Flush recessed ingrade / wall mounting installation sleeve with adjustable collar for precision mounting, see available options.
Protection	IP67
Resistance	Walkover rated only.

CERTIFICATIONS

cULus Class 2 Wet Location Listed.
Tested in accordance with LM-79-08.
Compliant for California installations.
Made in America, BAA, BABA

WARRANTY

5 year limited warranty.
⁴Fixture body complete with marine grade suitable for use in marine grade environments. Not to be in direct contact with salt or corrosive agents for extended periods of time.

SUSTAINABILITY

Luminaire designed for disposal/recycling at end-of-life. Replaceable LED light source and control gear by a Targetti technician.

ELECTRICAL CHARACTERISTICS

Driver	Remote Class 2 120V-277V AC power supply required, see available options.
Wattage	4W nominal
Voltage	24V DC
Operating Temp.	-25°C / +35°C

SOURCE

High Efficiency LED					
TM30	CCT (Nominal)	CRI	R _f	R _g	SDCM
	2200K	97	94	103	2
	2700K	98	95	102	2
	3000K	98	95	102	2
	3500K	97	90	98	2
	4000K	96	90	98	2

OPTIC

Direct view opal white lens.



Beam	DV	
Delivered Lumens	3000K	48Lm
	4000K	51Lm
For 2700K lumen values use multiplier of 0.96 from 3000K. For 3500K lumen values use multiplier of 1.02 from 3000K.		
Efficacy	10Lm/W max. Refer to photometric graphs for specific values.	
Lifetime	L70/B10 >35,000hrs at max TA +25°C	
Photobiological Classification	Low risk safety RG1	

SATURN

SPECIFICATION INFORMATION

SAT

1

2

3

4

5

6

7

8

9

10

REQUIRED

OPTIONAL

Ex: SATRPOVL13024 / DMLE301242UD / 1US3177S

1 - PRODUCT CODE	3 - DRIVER	4 - LENS	5 - WATTAGE	6 - KELVIN	7 - VOLTAGE
SAT — SATURN	RP — Remote Driver	DV — Direct View	L1 — 4W	22 — 2200K 27 — 2700K 30 — 3000K 35 — 3500K 40 — 4000K	24 — 24V DC
8 - DRIVER	9 - INSTALLATION	10 - INSTALLATION ACCESSORIES			
Power Supply See section for details	2" Installation Sleeve See section for details 3" Installation Sleeve See section for details 6" Installation Sleeve See section for details 9" Installation Sleeve See section for details	Sleeve mounting HUB See section for details Installation J-box See section for details			

SATURN

8 - POWER SUPPLY (REQUIRED)

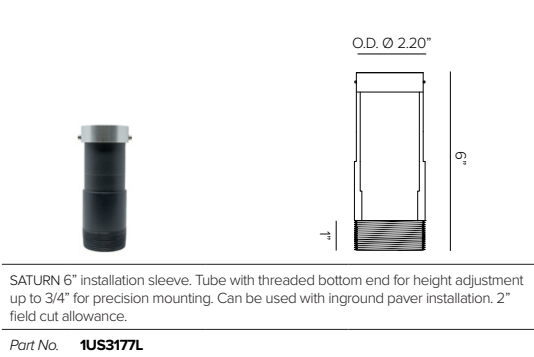
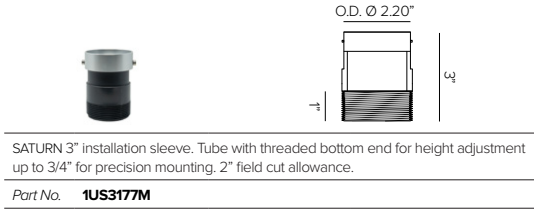
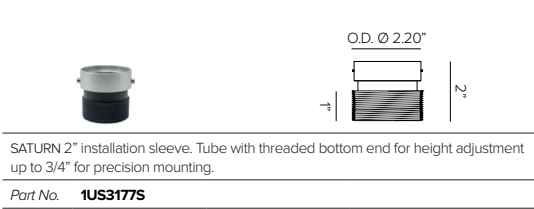
ENCLOSURE								
Part No.	Wattage	Control	Dim Range	Rating	In / Out Voltage	Certification	Dimensions (Enclosure)	Description
DMLE301242UD	30W	MLV / ELV / 0-10V / TRIAC	MLV / ELV <10% 0-10V 1%	NEMA3R	120-277V / 24V	UL Class 2	4.47" X 6.79" X 1.38"	EMCOD electronic driver with wiring compartment.
DELV30124DJBX	30W	0-10V	0.1%	IP65	120-277V / 24V	UL Class 2	12.1" X 2.4" X 1.4"	Magnitude SOLIDrive electronic driver with built in junction box.
DMLE601242UD	60W	MLV / ELV / 0-10V / TRIAC	MLV / ELV <10% 0-10V 1%	NEMA3R	120-277V / 24V	UL Class 2	4.47" X 6.79" X 1.38"	EMCOD electronic driver with wiring compartment.
DELV60124DJBX	60W	0-10V	0.1%	IP65	120-277V / 24V	UL Class 2	12.1" X 2.4" X 1.4"	Magnitude SOLIDrive electronic driver with built in junction box.
DMLE961242UD	96W	MLV / ELV / 0-10V / TRIAC	MLV / ELV <10% 0-10V 1%	NEMA3R	120-277V / 24V	UL Class 2	5.16" X 7.73" X 1.54"	EMCOD electronic driver with wiring compartment.
DELV96124DJBX	96W	0-10V	0.1%	IP65	120-277V / 24V	UL Class 2	12.1" X 2.4" X 1.4"	Magnitude SOLIDrive electronic driver with built in junction box.
DEDDX100241CDMX	100W	DMX 1Ch Group Control	0%	NEMA3R	120-277V / 24V	UR Class 2	12" x 12" x 4"	EldoLED LINEARdrive electronic driver.
DMLE1922242UD	2X96W	MLV / ELV / 0-10V / TRIAC	MLV / ELV <10% 0-10V 1%	NEMA3R	120-277V / 24V	UL Class 2	5.04" X 10.94" X 1.81"	EMCOD electronic driver with wiring compartment.
DEDDX200241CDMX	2X100W	DMX 1Ch Group Control	0%	NEMA3R	120-277V / 24V	UL Class 2	12" x 12" x 4"	EldoLED LINEARdrive electronic driver.
DMLE2882242UD	3X96W	MLV / ELV / 0-10V / TRIAC	MLV / ELV <10% 0-10V 1%	NEMA3R	120-277V / 24V	UL Class 2	5.04" X 10.94" X 1.81"	EMCOD electronic driver with wiring compartment.

STAND ALONE								
Part No.	Wattage	Control	Dim Range	Rating	In / Out Voltage	Certification	Dimensions (Standalone)	Description
DELV30124D	30W	0-10V	0.1%	IP65	120-277V / 24V	UR Class 2	7.5" X 2.4" X 1.4"	Magnitude SOLIDrive electronic standalone driver. UL listed enclosure provided by others.
DELV60124D	60W	0-10V	0.1%	IP65	120-277V / 24V	UR Class 2	7.5" X 2.4" X 1.4"	Magnitude SOLIDrive electronic standalone driver. UL listed enclosure provided by others.
DELV96124D	96W	0-10V	0.1%	IP65	120-277V / 24V	UR Class 2	7.5" X 2.4" X 1.4"	Magnitude SOLIDrive electronic standalone driver. UL listed enclosure provided by others.

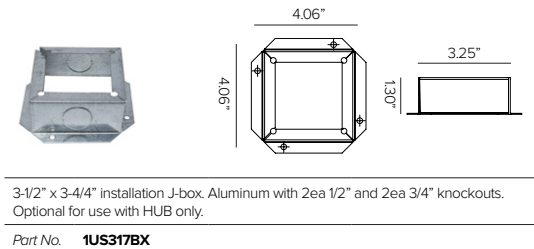
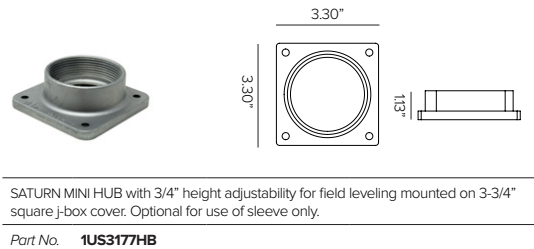
MAX FIXTURES PER DRIVER										
Fixture Wattage	Driver Wattage									
	30W	60W	90W	100W	2X90W	2X96W	2x100W	3X90W	3X96W	
4W	6	12	18	19	20	18+18	19+19	20+20	18+18+18	19+19+19

SATURN

9 – INSTALLATION (REQUIRED)

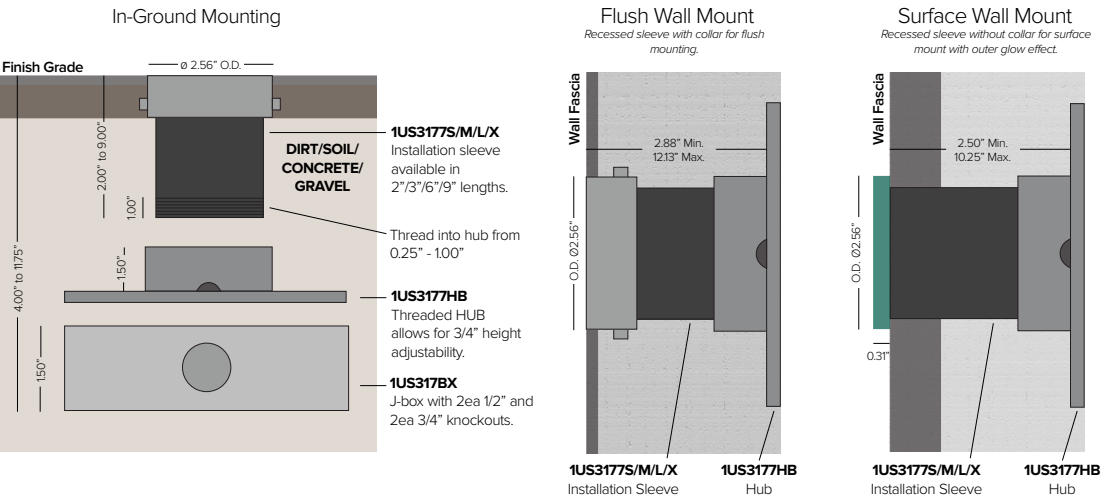


10 – INSTALLATION ACCESSORIES (OPTIONAL)



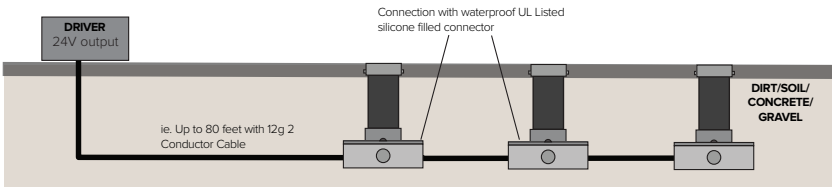
SATURN

INSTALLATION DIAGRAMS



Overall Heights
2" Installation Sleeve = 4.00" Min to 4.75" Max
3" Installation Sleeve = 5.00" Min to 5.75" Max
6" Installation Sleeve = 8.00" Min to 8.75" Max
9" Installation Sleeve = 11.00" Min to 11.75" Max

WIRING DIAGRAM



NOTE Low voltage outdoor landscape wiring to be installed by a certified electrician per local building requirements, max 4A 96W circuit.

SATURN

PHOTOMETRY



March 22, 2026

Project

WWII Monument

Torrance, CA

OCULUS LIGHT STUDIO

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Luminaire Type

LG2

Application

Flush in-grade small-scale asymmetric floodlights. Designed for directional lighting, uplighting of trees, walls, columns, or signage from ground surfaces. Luminaires require a remote 24 V DC class 2 power supply suitable to operate at the intended LED wattage.

Materials

Clear safety glass
Corrosion-resistant 304 grade stainless steel
High temperature silicone gasket
Mechanically captive stainless steel fasteners
Pure anodized aluminum reflector

NRTL listed to North American Standards, suitable for wet locations
Protection class IP 68

Weight: 3.1 lbs.

Electrical

Operating voltage	24VDC (remote power supply req.)
Minimum start temperature	-40° C
LED module wattage	3.0W
System wattage	5.8W
Controllability	Non-Dimming
Color rendering index	Ra > 80
Luminaire lumens	364 lm
LED service life (L70)	60000 hrs

LED color temperature

4000K (K4)
3500K (K35)
3000K (K3)
2700K (K27)

BEGA can supply you with suitable LED replacement modules for up to 20 years after the purchase of LED luminaires - see website for details

Finish

#4 brushed stainless steel. Custom colors are not available.

Type:

BEGA Product:

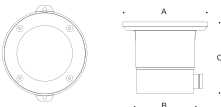
Project:

Modified:

Available accessories

B19580 Remote driver box · Static white
B19591 Remote driver box · Static white

See individual accessory spec sheet for details.

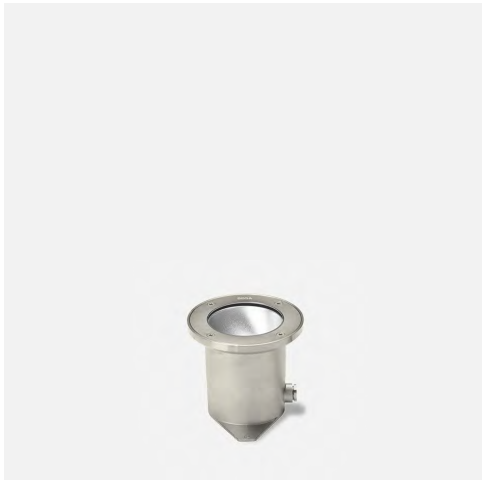


In-grade luminaire · Asymmetric · 24V DC

	LED	β	A	B	C
B77019	3.0W	38°x35°	4 ⁵ / ₈	3 ¹ / ₈	3 ⁷ / ₈

BEGA 1000 BEGA Way, Carpinteria, CA 93013 (805)684-0533 info@bega-us.com

Due to the dynamic nature of lighting products and the associated technologies, luminaire data on this sheet is subject to change at the discretion of BEGA North America. For the most current technical data, please refer to bega-us.com
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Luminaire Type

LG3

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139-2124_min

FLC220 LED GOBO PROJECTOR

we-ef



Description

Profile Projector [GP] for projection of gobos on a surface.

Spherical and aspherical, double flat convex lens system.
Aperture angle ranges from 12-16°.

Gobo size G. Gobo outside diameter 66 mm, max printable
area d = 48 mm. WE-EF recommends d = 38 mm.

IP66. Class I. IK07. Marine-grade, die-cast aluminum alloy.
5CE superior corrosion protection including PCS hardware.
Silicone CCG® Controlled Compression Gasket. Safety
glass main lens. One cable gland, second gland for through
wiring on request. PMMA LED lens array. Integral driver,
thermally separated. Factory-installed LED circuit board.
LED board can be removed for upgrading.

Specify product with 7 Digit product code - Finish Color.
Accessories, such as mounting, optical, and electrical, must
be specified separately.

Example: XXX-XXXX-9004 (Black)

+ XXX-XXXX (Accessory 1)

Weight	18.08 lb
Light distribution	symmetric Gobo-Projector [GP] - min aperture angle
Light source	LED-FT-37W (4000K)
CRI	80
Power supply	electronic gear
LEDs	1
Rated input power	42 W

Delivered lumens (lm)

LED Lumen	1396.3
Total Lumen	1396.3
Ta	25

Nominal Lumen (lm)

LED Lumen	4900
Total Lumen	4900
Tc	25

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Project

Luminaire Type

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LL-F1

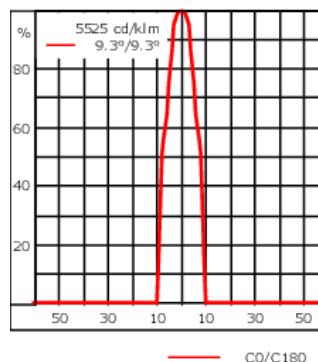
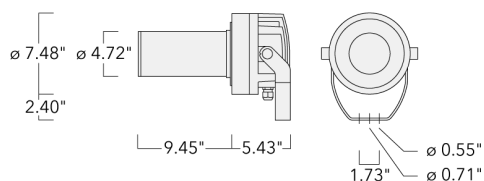
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FLC220 LED GOBO PROJECTOR

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Specifications

Material description

Body	Marine-grade, die-cast aluminium alloy
Lens	Safety glass lens
Colors	<div><div></div> RAL9004 Black</div> <div><div></div> RAL9007 Grey Metallic</div> <div><div></div> RAL9016 White</div> <div><div></div> RAL8019 Dark Bronze</div>
Gasket	Silicone CCG® Controlled Compression Gasket
Fasteners	PCS Polymer Coated Stainless Steel Hardware
Ingress protection	IP66
Impact resistance	IK07
Corrosion resistance	5CE
Windage	0.503

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FLC220 LED GOBO PROJECTOR

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Electrical description

Power supply	Integral [ECG] electronic driver 120V-277V. 0-10V dimmable, to be specified with order.
Driver / Ballast	Integral EC electronic converter in thermally-separated compartment
Power factor	> 0.9
Surge protection	Integral 10kV Surge Protector

Additional information

Lifetime	Ta=25°/40° L70B50 > 50000h
Listings	ETL, UL-1598, CSA-C22.2#250.0. Suitable for Wet Locations.

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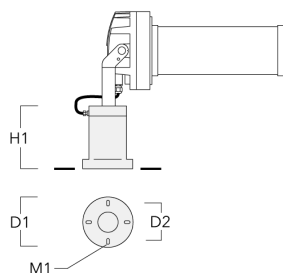
FLC220 LED GOBO PROJECTOR

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Mounting Accessories

Short post EM

Description	Part ID	D1	D2	H1	M1	Weight (lb)
EM1-M16	270-9038	6.3	5.12	7.87"	0.35"	4.85 lbs



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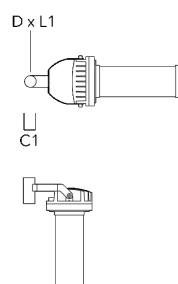
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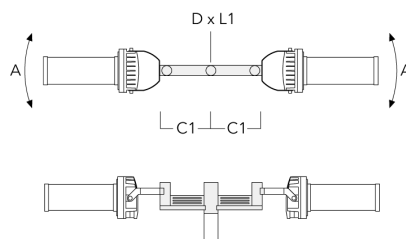
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Floodlight mounting bracket TA

Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA1 Mounting bracket, single (Ø 4.25 x 8)	147-0096		5.12	4.25 x 8	4.25	16.53	108 x 200



TA2-L Mounting bracket, double (Ø 3 x 8)	147-0105	±90°	16.54	3 x 8	2.99	35.49	76 x 200
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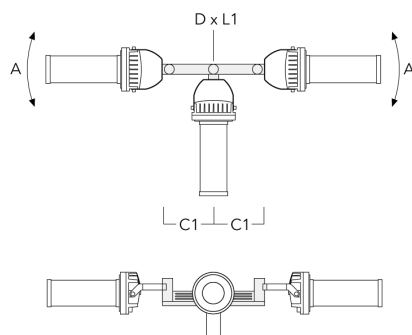
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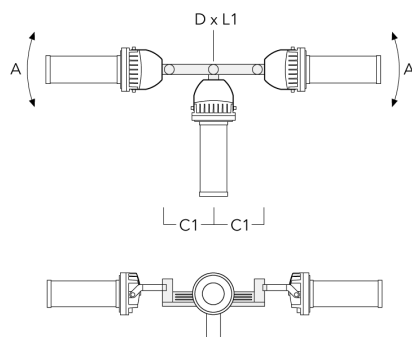
FLC220 LED GOBO PROJECTOR

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Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA3 Mounting bracket, triple (Ø 3.50 x 8)	147-0025	±90°	25.59	3.50 x 8	3.5	39.46	89 x 200



TA3 Mounting bracket, triple (Ø 4.25 x 8)	147-0098	±90°	25.59"	4.25 x 8		53.35 lbs	108 x 200
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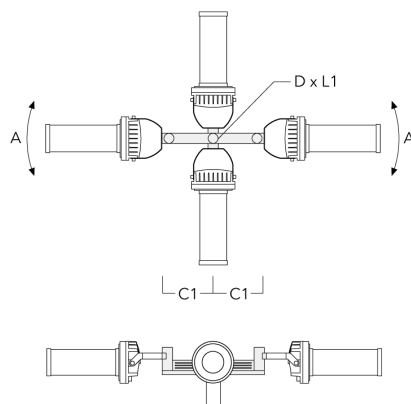
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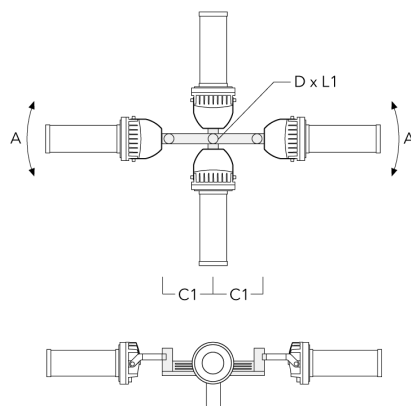
FLC220 LED GOBO PROJECTOR

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Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA4 Mounting bracket, quad (Ø 3.50 x 8)	147-0099	±90°	25.59	3.50 x 8		45.86 lbs	89 x 200



TA4 Mounting bracket, quad (Ø 4.25 x 8)	147-0100	±90°	650	4.25 x 8		53.00	108 x 200
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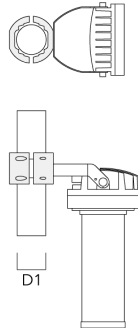
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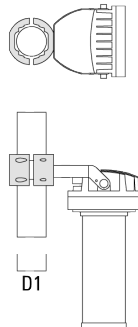
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Pole clamp TS

Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 4.0"-4.5")	147-0526	4.0-4.50	3.53	102-114



TS1-2/M12 Pole clamp, single (Ø 4.5"-5.25")	147-0544	114-133	3.75	114-133
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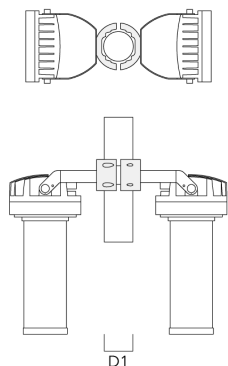
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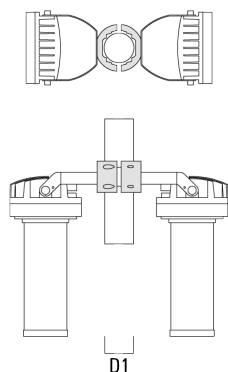
FLC220 LED GOBO PROJECTOR

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Description	Part ID	D1	Weight (lb)	D
TS2-2/M16 Pole clamp, double (Ø 4.0"-4.5")	147-0527	4.0-4.50	3.31	102-114



TS2-2/M12 Pole clamp, double (Ø 3"-3.5")	147-0545	3.0"-3.5"	3.09 lbs	76-89
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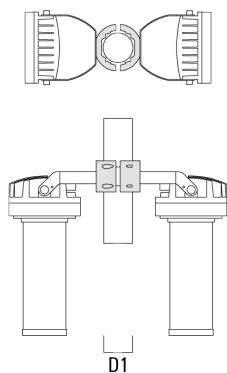
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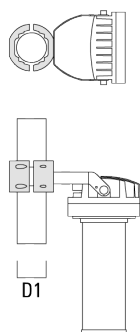
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Description	Part ID	D1	Weight (lb)	D
TS2-2/M16 Pole clamp, double (Ø 4.5"-5.25")	147-0546	4.50-5.25	3.53	114-133



TS1-2/M12 Pole clamp, single (Ø 3"-3.5")	147-0543	3.0-3.50	3.31	76-89
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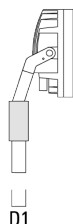
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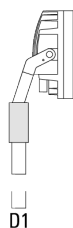
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Pole top caps KF

Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-60/M16 Spigot Cap (Ø 2.36")	310-9120	2.36	2.36 x 4	4.4 lbs	60 x 100



KF16-76/M16 Spigot Cap (Ø 3.0")	310-9121	3	3 x 4	1.10 lbs	76 x 100
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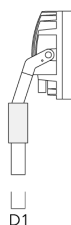
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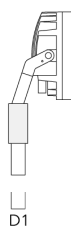
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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-89/M16 Spigot Cap (Ø 3.5")	300-0734	3.50	3.5 x 3	1.10 lbs	89



KF16-108/M16 Spigot Cap (Ø 4.25")	300-0735	4.25	4.25 x 3	4.4 lbs	108
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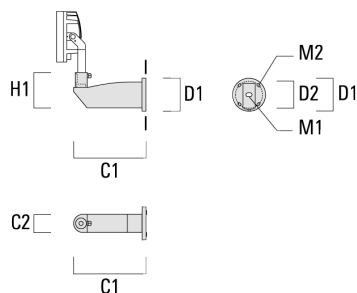
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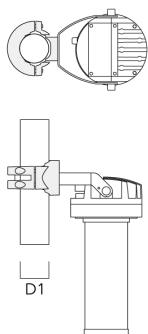
Wall Mount Bracket WMB

Description	Part ID	C1	C2	D1	D2	H1	M1	M2	Weight (lb)
WMB200 Wall mount bracket	147-6015	20.28	4.72	9.25	7.88	11.34	1.05	0.47	20.0 lbs



Pole clamp PC

Description	Part ID	D1	Weight (lb)
PC1 76-89/60 Pole clamp, single (Ø 3"-3.5")	139-2702	3.0-3.50	2.20



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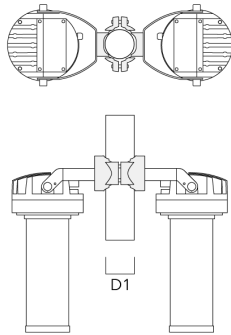
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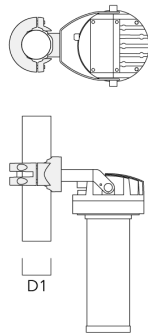
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Description	Part ID	D1	Weight (lb)
PC2 76-89/60 Pole clamp, double (Ø 3"-3.5")	139-2703	3.0-3.50	2.20



PC1 82-109/60 Pole camp, single (Ø 3.25"-4.3")	139-2704	3.20-4.30	2.40
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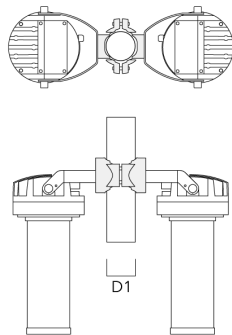
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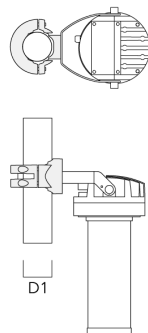
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Description	Part ID	D1	Weight (lb)
PC2 82-109/60 Pole clamp, double (Ø 3.25"-4.25")	139-2705	3.20-4.30	2.40



PC1 102-114/60 Pole clamp, single (Ø 4"-4,5")	139-2706	4.0-4.50	2.65
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LL-F1

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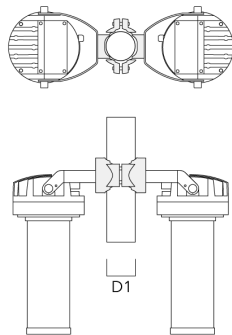
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139-2124_min

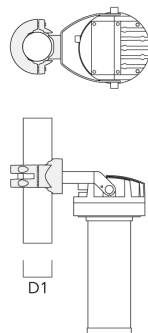
FLC220 LED GOBO PROJECTOR

we-ef

Description	Part ID	D1	Weight (lb)
PC2 102-114/60 Pole clamp, double (Ø 4"-4.5")	139-2707	4.0-4.50	2.65



PC1 114-133/60 Pole clamp, single (Ø 4.5"-5.25")	139-2708	4.5-5.25	3.10
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March 22, 2026

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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F1

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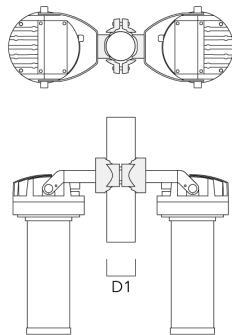
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139-2124_min

FLC220 LED GOBO PROJECTOR

we-ef

Description	Part ID	D1	Weight (lb)
PC2 114-133/60 Pole clamp, double (Ø 4.5"-5.25")	139-2709	4.5-5.25	3.10



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Project

Luminaire Type

WWII Monument

Torrance, CA

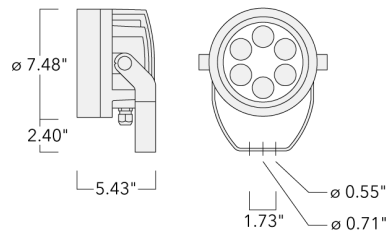
LL-F1

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FLC220 LED Floodlights

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Description

3G Vibration Certified.

IP66. Class I. IK07. Marine-grade, die-cast aluminum alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. Safety glass lens. One cable gland, second gland for through wiring on request. CAD-optimized optics for superior illumination and glare control. Integral driver, thermally separated. OLC® One LED Concept. Factory-installed LED circuit board. 0-10V Dimming comes standard with luminaire.

Optional 2200 K version available. To be specified at time of ordering.

A maximum of one internal optical accessory.

Specify product with 7 Digit product code - Finish Color. Accessories, such as mounting, optical, and electrical, must be specified separately.

Example: XXX-XXXX-9004 (Black)
+ XXX-XXXX (Accessory 1)

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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F2

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FLC220 LED

Floodlights

we-ef

Specifications

Material description

Body	Marine-grade, die-cast aluminium alloy
Lens	Safety glass lens
Colors	<div><div></div> RAL9004 Black</div> <div><div></div> RAL9007 Grey Metallic</div> <div><div></div> RAL9016 White</div> <div><div></div> RAL8019 Dark Bronze</div>
Gasket	Silicone CCG® Controlled Compression Gasket
Fasteners	PCS Polymer Coated Stainless Steel Hardware
Ingress protection	IP66
Impact resistance	IK07
Corrosion resistance	5CE
Windage	0.372

Electrical description

Power supply	Integral [ECG] electronic driver 120V-277V. 0-10V dimmable, to be specified with order.
Driver / Ballast	ECG in thermally-separated compartment
Surge protection	Integral 10kV Surge Protector

Additional information

Lifetime	Ta=25°/40° L90B10 > 90000h
Lead Time	This is a new product release and may have an extended lead time.
Listings	ETL, UL-1598, CSA-C22.2#250.0. Suitable for Wet Locations. Meets ANSI C136.31 - 3G Vibration Rating for Bridge and Overpass Applications.

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Project

WWII Monument

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Luminaire Type

LL-F2

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FLC220 LED

Floodlights

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Options

Light distribution



symmetric, wide beam [W]



symmetric, medium beam [M]



symmetric, narrow beam [N]



symmetric, very narrow beam [VN]



symmetric, very narrow beam, 'sharp cut-off' [VNS]



wallwash



linear spread, very narrow beam [VN]



linear spread, very narrow beam, 'sharp cut-off'

Color temperature



3000 K



4000 K



2700 K

Nominal Watt

0 W

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Project

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Luminaire Type

LL-F2

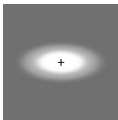
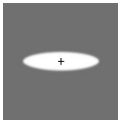


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FLC220 LED

Floodlights

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Configurations

Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
linear spread, very narrow beam [VN] 	139-2005+139-2036	LED-6/12W / 700 mA - 3000 K	1487	14.5 W	80	9.48
	139-2006+139-2036	LED-6/12W / 700 mA - 4000 K	1589.5	14.5 W	80	9.48
	139-2015+139-2036	LED-6/18W / 1050 mA - 3000 K	2204.8	21 W	80	9.48
	139-2016+139-2036	LED-6/18W / 1050 mA - 4000 K	2307.4	21 W	80	9.48
	139-2030+139-2036	LED-6/26W / 1400 mA - 3000 K	2712.7	29 W	80	9.48
	139-2031+139-2036	LED-6/26W / 1400 mA - 4000 K	2836	29 W	80	9.48
	139-2261+139-2036	LED-6/12W / 700 mA - 2700 K	1384.4	14.5 W	80	9.48
	139-2269+139-2036	LED-6/18W / 1050 mA - 2700 K	2102.3	21 W	80	9.48
	139-2276+139-2036	LED-6/26W / 1400 mA - 2700K	2564.7	29 W	80	9.48
linear spread, very narrow beam, 'sharp cut-off' 	139-2007+139-2036	LED-6/12W / 700 mA - 3000 K	1203.4	14.5 W	80	9.48
	139-2008+139-2036	LED-6/12W / 700 mA - 4000 K	1349.3	14.5 W	80	9.48
	139-2017+139-2036	LED-6/18W / 1050 mA - 3000 K	1729.2	21 W	80	9.48
	139-2018+139-2036	LED-6/18W / 1050 mA - 4000 K	1938.8	21 W	80	9.48
	139-2032+139-2036	LED-6/26W / 1400 mA - 3000 K	2128.7	29 W	80	9.48
	139-2033+139-2036	LED-6/26W / 1400 mA - 4000 K	2384	29 W	80	9.48
	139-2262+139-2036	LED-6/12W / 700 mA - 2700 K	1131	14.5 W	80	9.48
	139-2270+139-2036	LED-6/18W / 1050 mA - 2700 K	1624.4	21 W	80	9.50
	139-2277+139-2036	LED-6/26W / 1400 mA - 2700 K	1997.7	29 W	80	9.48
symmetric, medium beam [M] 	139-2001	LED-6/12W / 700 mA - 3000 K	1533.6	14.5 W	80	9.50
	139-2002	LED-6/12W / 700 mA - 4000 K	1639.3	14.5 W	80	9.50
	139-2011	LED-6/18W / 1050 mA - 3000 K	2273.9	21 W	80	9.50
	139-2012	LED-6/18W / 1050 mA - 4000 K	2379.6	21 W	80	9.50
	139-2026	LED-6/26W / 1400 mA - 3000 K	2821.4	29 W	80	9.50
	139-2027	LED-6/26W / 1400 mA - 4000 K	2949.6	29 W	80	9.50
	139-2187	LED-6/26W / 1400 mA - 2700K	2667.5	29 W	80	9.50
	139-2244	LED-6/18W / 1050 mA - 2700 K	2168.1	21 W	80	9.50
	139-2247	LED-6/12W / 700 mA - 2700 K	1427.8	14.5 W	80	9.50
symmetric, narrow beam [N] 	139-2003	LED-6/12W / 700 mA - 3000 K	1473.8	14.5 W	80	9.50
	139-2004	LED-6/12W / 700 mA - 4000 K	1575.5	14.5 W	80	9.50
	139-2013	LED-6/18W / 1050 mA - 3000 K	2185.4	21 W	80	9.50
	139-2014	LED-6/18W / 1050 mA - 4000 K	2287	21 W	80	9.50
	139-2028	LED-6/26W / 1400 mA - 3000 K	2711.6	29 W	80	9.50

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Project

WWII Monument

Torrance, CA

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Luminaire Type

LL-F2


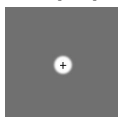
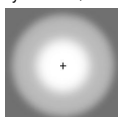
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FLC220 LED Floodlights

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Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
	139-2029	LED-6/26W / 1400 mA - 4000 K	2834.8	29 W	80	9.50
	139-2224	LED-6/26W / 1400 mA - 2700K	2563.7	29 W	80	9.50
	139-2245	LED-6/18W / 1050 mA - 2700 K	2083.7	21 W	80	9.50
	139-2248	LED-6/12W / 700 mA - 2700 K	1372.2	14.5 W	80	9.50
	139-2005	LED-6/12W / 700 mA - 3000 K	1559.6	14.5 W	80	9.50
	139-2006	LED-6/12W / 700 mA - 4000 K	1667.2	14.5 W	80	9.50
	139-2015	LED-6/18W / 1050 mA - 3000 K	2312.6	21 W	80	9.50
	139-2016	LED-6/18W / 1050 mA - 4000 K	2420.1	21 W	80	9.50
	139-2030	LED-6/26W / 1400 mA - 3000 K	2869.2	29 W	80	9.50
	139-2031	LED-6/26W / 1400 mA - 4000 K	2999.6	29 W	80	9.50
	139-2261	LED-6/12W / 700 mA - 2700 K	1452.1	14.5 W	80	9.50
	139-2269	LED-6/18W / 1050 mA - 2700 K	2205	21 W	80	9.50
	139-2276	LED-6/26W / 1400 mA - 2700K	2712.7	29 W	80	9.50
	139-2007	LED-6/12W / 700 mA - 3000 K	1234.8	14.5 W	80	9.50
	139-2008	LED-6/12W / 700 mA - 4000 K	1384.4	14.5 W	80	9.50
	139-2017	LED-6/18W / 1050 mA - 3000 K	1774.2	21 W	80	9.50
	139-2018	LED-6/18W / 1050 mA - 4000 K	1989.3	21 W	80	9.50
	139-2032	LED-6/26W / 1400 mA - 3000 K	2203.5	29 W	80	9.50
	139-2033	LED-6/26W / 1400 mA - 4000 K	2467.7	29 W	80	9.50
	139-2262	LED-6/12W / 700 mA - 2700 K	1160.4	14.5 W	80	9.50
	139-2270	LED-6/18W / 1050 mA - 2700 K	1666.7	21 W	80	9.50
	139-2277	LED-6/26W / 1400 mA - 2700 K	2067.9	29 W	80	9.50
	139-1999	LED-6/12W / 700 mA - 3000 K	1492	14.5 W	80	9.50
	139-2000	LED-6/12W / 700 mA - 4000 K	1594.9	14.5 W	80	9.50
	139-2009	LED-6/18W / 1050 mA - 3000 K	2212.3	21 W	80	9.50
	139-2010	LED-6/18W / 1050 mA - 4000 K	2315.2	21 W	80	9.50
	139-2024	LED-6/26W / 1400 mA - 3000 K	2744.9	29 W	80	9.50
wallwash	139-2025	LED-6/26W / 1400 mA - 4000 K	2869.7	29 W	80	9.50
	139-2186	LED-6/26W / 1400 mA - 2700K	2675.4	29 W	80	9.50
	139-2243	LED-6/18W / 1050 mA - 2700 K	2109.4	21 W	80	9.50
	139-2246	LED-6/12W / 700 mA - 2700 K	1389.1	14.5 W	80	9.50
	139-2001+139-2035-AP	LED-6/12W / 700 mA - 3000 K	1285.2	14.5 W	80	9.48
	139-2002+139-2035-AP	LED-6/12W / 700 mA - 4000 K	1373.8	14.5 W	80	9.48

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Project

WWII Monument

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Luminaire Type

LL-F2

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FLC220 LED Floodlights

we-ef

Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
	139-2011+139-2035-AP	LED-6/18W / 1050 mA - 3000 K	1905.6	21 W	80	9.48
	139-2012+139-2035-AP	LED-6/18W / 1050 mA - 4000 K	1994.3	21 W	80	9.48
	139-2026+139-2035-AP	LED-6/26W / 1400 mA - 3000 K	2364.4	29 W	80	9.48
	139-2027+139-2035-AP	LED-6/26W / 1400 mA - 4000 K	2471.8	29 W	80	9.48
	139-2187+139-2035-AP	LED-6/26W / 1400 mA - 2700K	2235.4	29 W	80	9.48
	139-2244+139-2035-AP	LED-6/18W / 1050 mA - 2700 K	1817	21 W	80	9.48
	139-2247+139-2035-AP	LED-6/12W / 700 mA - 2700 K	1196.6	14.5 W	80	9.50

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Project

Luminaire Type

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FLC220 LED

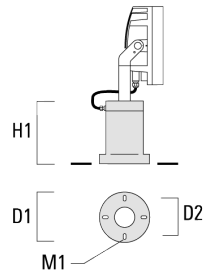
Floodlights

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Mounting Accessories

Short post EM

Description	Part ID	D1	D2	H1	M1	Weight (lb)
EM1-M16 AL - Single Cable Entry	270-9038	6.3	5.12	7.87"	0.35"	4.85 lbs



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Luminaire Type

WWII Monument

Torrance, CA

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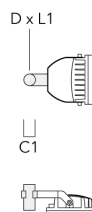
FLC220 LED

Floodlights

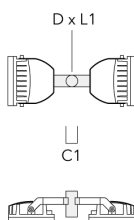
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Floodlight mounting bracket TA

Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA1 Mounting bracket, single (Ø 4.25 x 8)	147-0096		5.12	4.25 x 8	4.25	16.53	108 x 200



TA2 Mounting bracket, double (Ø 4.25 x 8)	147-0097		5.12	4.25 x 8	4.25	16.53	108 x 200
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Luminaire Type

WWII Monument

Torrance, CA

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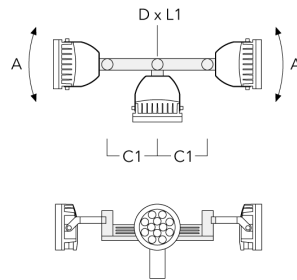
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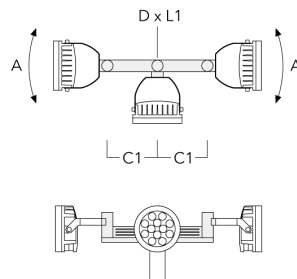
FLC220 LED
Floodlights

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Description	Part ID	A	C1	D × L1	L	Weight (lb)	D × S
TA3 Mounting bracket, triple (Ø 3.50 x 8)	147-0025	±90°	25.59	3.50 x 8	3.5	39.46	89 x 200



TA3 Mounting bracket, triple (Ø 4.25 x 8)	147-0098	±90°	25.59"	4.25 x 8		53.35 lbs	108 x 200
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Luminaire Type

WWII Monument

Torrance, CA

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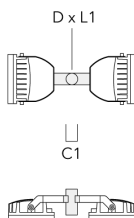
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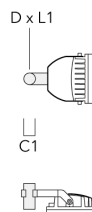
FLC220 LED **Floodlights**

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Description	Part ID	A	C1	D × L1	L	Weight (lb)	D × S
TA2 Mounting bracket, double (Ø 3 x 8)	147-0024		5.12	3 x 8	2.99	4.2 lbs	76 x 200



TA1 Mounting bracket, single (Ø 3 x 8)	147-0023		5.12	3 x 8	2.99	4.19	76 x 200
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Luminaire Type

WWII Monument

Torrance, CA

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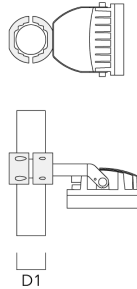
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FLC220 LED
Floodlights

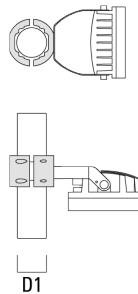
we-ef

Pole clamp TS

Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 4.0"-4.5")	147-0526	4.0-4.50	3.53	102-114



TS1-2/M12 Pole clamp, single (Ø 4.5"-5.25")	147-0544	114-133	3.75	114-133
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Luminaire Type

WWII Monument

Torrance, CA

LL-F2

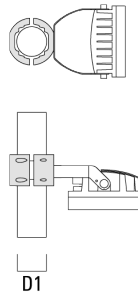
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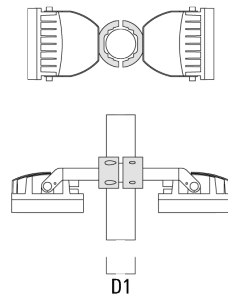
FLC220 LED
Floodlights

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Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 3"-3.5")	147-0543	3.0-3.50	3.31	76-89



TS2-2/M12 Pole clamp, double (Ø 3"-3.5")	147-0545	3.0"-3.5"	3.09 lbs	76-89
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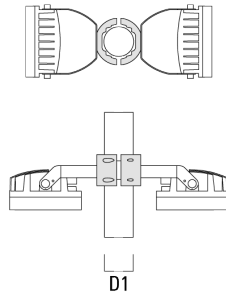
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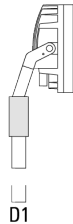
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Description	Part ID	D1	Weight (lb)	D
TS2-2/M16 Pole clamp, double (Ø 4.5"-5.25")	147-0546	4.50-5.25	3.53	114-133



Pole top caps KF

Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-60/M16 Spigot Cap (Ø 2.36")	310-9120	2.36	2.36 x 4	4.4 lbs	60 x 100



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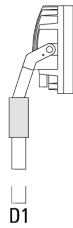
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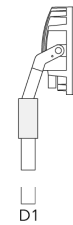
FLC220 LED
Floodlights

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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-76/M16 Spigot Cap (Ø 3.0")	310-9121	3	3 x 4	1.10 lbs	76 x 100



KF16-89/M16 Spigot Cap (Ø 3.5")	300-0734	3.50	3.5 x 3	1.10 lbs	89
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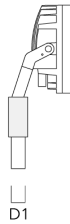
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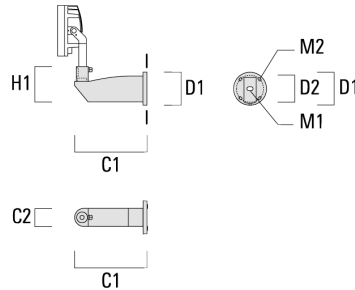
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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-108/M16 Spigot Cap (Ø 4.25")	300-0735	4.25	4.25 x 3	4.4 lbs	108



Wall Mount Bracket WMB

Description	Part ID	C1	C2	D1	D2	H1	M1	M2	Weight (lb)
WMB200 Wall mount bracket	147-6015	20.28	4.72	9.25	7.88	11.34	1.05	0.47	20.0 lbs



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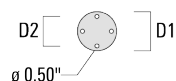
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Surface Mount Canopy SMC

Description	Part ID	D1	D2	Weight (lb)
SMC-200	147-6915	10.83	9.25	15.4 lbs



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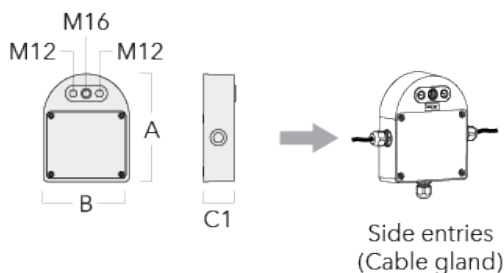
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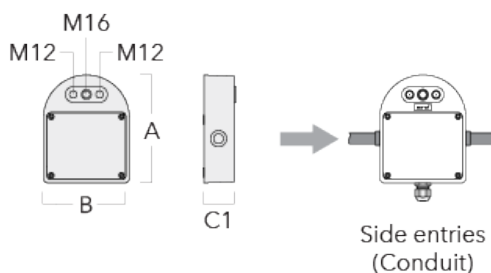
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Junction box

Description	Part ID	Additional information	A	B	C1	Weight (lb)
Junction box JB20 - Cable side entries	310-9013	Junction boxes are made from marine-grade, die-cast aluminium alloy. IK10. IP66. For side entries and suitable to be used with cable glands.	7.09	5.63	2.01	2.25



Junction box JB20 - Conduit side entries	310-9014	Junction boxes are made from marine-grade, die-cast aluminium alloy. IK10. IP66. For side entries and suitable to be used with conduits.	7.09	5.63	2.01	2.25
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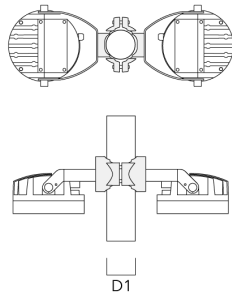
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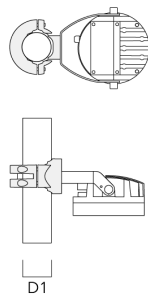
we-ef

Pole clamp PC

Description	Part ID	D1	Weight (lb)
PC2 76-89/60 Pole clamp, double (Ø 3"-3.5")	139-2703	3.0-3.50	2.20



PC1 76-89/60 Pole clamp, single (Ø 3"-3.5")	139-2702	3.0-3.50	2.20
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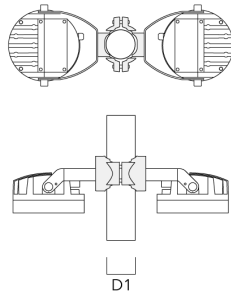
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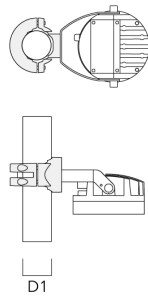
FLC220 LED
Floodlights

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Description	Part ID	D1	Weight (lb)
PC2 102-114/60 Pole clamp, double (Ø 4"-4.5")	139-2707	4.0-4.50	2.65



PC1 102-114/60 Pole clamp, single (Ø 4"-4,5")	139-2706	4.0-4.50	2.65
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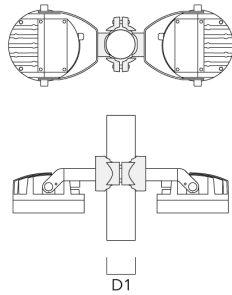
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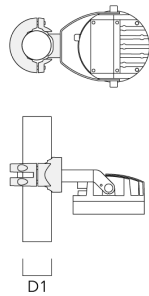
FLC220 LED **Floodlights**

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Description	Part ID	D1	Weight (lb)
PC2 114-133/60 Pole clamp, double (Ø 4.5"-5.25")	139-2709	4.5-5.25	3.10



PC1 114-133/60 Pole clamp, single (Ø 4.5"-5.25")	139-2708	4.5-5.25	3.10
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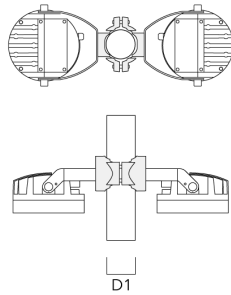
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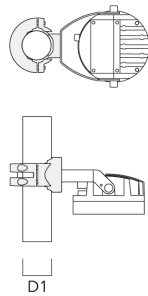
FLC220 LED **Floodlights**

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Description	Part ID	D1	Weight (lb)
PC2 82-109/60 Pole clamp, double (Ø 3.25"-4.25")	139-2705	3.20-4.30	2.40



PC1 82-109/60 Pole camp, single (Ø 3.25"-4.3")	139-2704	3.20-4.30	2.40
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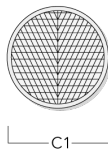
Floodlights

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Optical Accessories

Wallwash lens

Description	Part ID	C1
IO-20-FLC220-LED	139-2035	5.75



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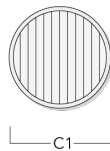
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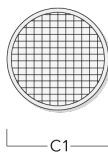
Linear spread lens

Description	Part ID	C1
IO-180-FLC220-LED	139-2036	5.75



Softening Lens

Description	Part ID	C1
IO-360-FLC220-LED	139-2037	5.75



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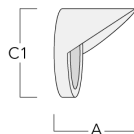
Honeycomb louvre

Description	Part ID	C1
IW-FLC220-LED	139-2034	5.43



Glare shield

Description	Part ID	A	C1
ES-FLC220-LED	139-1986	4.92	7.48



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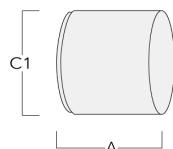
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Snoot

Description	Part ID	A	C1
ET-FLC220-LED	139-1987	4.92	7.48



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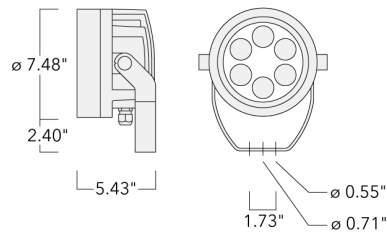
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FLC220 LED Floodlights

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Description

3G Vibration Certified.

IP66. Class I. IK07. Marine-grade, die-cast aluminum alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. Safety glass lens. One cable gland, second gland for through wiring on request. CAD-optimized optics for superior illumination and glare control. Integral driver, thermally separated. OLC® One LED Concept. Factory-installed LED circuit board. 0-10V Dimming comes standard with luminaire.

Optional 2200 K version available. To be specified at time of ordering.

A maximum of one internal optical accessory.

Specify product with 7 Digit product code - Finish Color. Accessories, such as mounting, optical, and electrical, must be specified separately.

Example: XXX-XXXX-9004 (Black)
+ XXX-XXXX (Accessory 1)

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FLC220 LED

Floodlights

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Specifications

Material description

Body	Marine-grade, die-cast aluminium alloy
Lens	Safety glass lens
Colors	<div><div></div> RAL9004 Black</div> <div><div></div> RAL9007 Grey Metallic</div> <div><div></div> RAL9016 White</div> <div><div></div> RAL8019 Dark Bronze</div>
Gasket	Silicone CCG® Controlled Compression Gasket
Fasteners	PCS Polymer Coated Stainless Steel Hardware
Ingress protection	IP66
Impact resistance	IK07
Corrosion resistance	5CE
Windage	0.372

Electrical description

Power supply	Integral [ECG] electronic driver 120V-277V. 0-10V dimmable, to be specified with order.
Driver / Ballast	ECG in thermally-separated compartment
Surge protection	Integral 10kV Surge Protector

Additional information

Lifetime	Ta=25°/40° L90B10 > 90000h
Lead Time	This is a new product release and may have an extended lead time.
Listings	ETL, UL-1598, CSA-C22.2#250.0. Suitable for Wet Locations. Meets ANSI C136.31 - 3G Vibration Rating for Bridge and Overpass Applications.

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Options

Light distribution



symmetric, wide beam [W]



symmetric, medium beam [M]



symmetric, narrow beam [N]



symmetric, very narrow beam [VN]



symmetric, very narrow beam, 'sharp cut-off' [VNS]



wallwash



linear spread, very narrow beam [VN]



linear spread, very narrow beam, 'sharp cut-off'

Color temperature



3000 K



4000 K



2700 K

Nominal Watt

0 W

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Luminaire Type

LL-F3

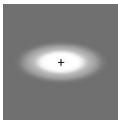
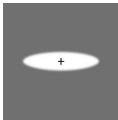


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FLC220 LED

Floodlights

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Configurations

Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
linear spread, very narrow beam [VN] 	139-2005+139-2036	LED-6/12W / 700 mA - 3000 K	1487	14.5 W	80	9.48
	139-2006+139-2036	LED-6/12W / 700 mA - 4000 K	1589.5	14.5 W	80	9.48
	139-2015+139-2036	LED-6/18W / 1050 mA - 3000 K	2204.8	21 W	80	9.48
	139-2016+139-2036	LED-6/18W / 1050 mA - 4000 K	2307.4	21 W	80	9.48
	139-2030+139-2036	LED-6/26W / 1400 mA - 3000 K	2712.7	29 W	80	9.48
	139-2031+139-2036	LED-6/26W / 1400 mA - 4000 K	2836	29 W	80	9.48
	139-2261+139-2036	LED-6/12W / 700 mA - 2700 K	1384.4	14.5 W	80	9.48
	139-2269+139-2036	LED-6/18W / 1050 mA - 2700 K	2102.3	21 W	80	9.48
	139-2276+139-2036	LED-6/26W / 1400 mA - 2700K	2564.7	29 W	80	9.48
linear spread, very narrow beam, 'sharp cut-off' 	139-2007+139-2036	LED-6/12W / 700 mA - 3000 K	1203.4	14.5 W	80	9.48
	139-2008+139-2036	LED-6/12W / 700 mA - 4000 K	1349.3	14.5 W	80	9.48
	139-2017+139-2036	LED-6/18W / 1050 mA - 3000 K	1729.2	21 W	80	9.48
	139-2018+139-2036	LED-6/18W / 1050 mA - 4000 K	1938.8	21 W	80	9.48
	139-2032+139-2036	LED-6/26W / 1400 mA - 3000 K	2128.7	29 W	80	9.48
	139-2033+139-2036	LED-6/26W / 1400 mA - 4000 K	2384	29 W	80	9.48
	139-2262+139-2036	LED-6/12W / 700 mA - 2700 K	1131	14.5 W	80	9.48
	139-2270+139-2036	LED-6/18W / 1050 mA - 2700 K	1624.4	21 W	80	9.50
	139-2277+139-2036	LED-6/26W / 1400 mA - 2700 K	1997.7	29 W	80	9.48
symmetric, medium beam [M] 	139-2001	LED-6/12W / 700 mA - 3000 K	1533.6	14.5 W	80	9.50
	139-2002	LED-6/12W / 700 mA - 4000 K	1639.3	14.5 W	80	9.50
	139-2011	LED-6/18W / 1050 mA - 3000 K	2273.9	21 W	80	9.50
	139-2012	LED-6/18W / 1050 mA - 4000 K	2379.6	21 W	80	9.50
	139-2026	LED-6/26W / 1400 mA - 3000 K	2821.4	29 W	80	9.50
	139-2027	LED-6/26W / 1400 mA - 4000 K	2949.6	29 W	80	9.50
	139-2187	LED-6/26W / 1400 mA - 2700K	2667.5	29 W	80	9.50
	139-2244	LED-6/18W / 1050 mA - 2700 K	2168.1	21 W	80	9.50
	139-2247	LED-6/12W / 700 mA - 2700 K	1427.8	14.5 W	80	9.50
symmetric, narrow beam [N] 	139-2003	LED-6/12W / 700 mA - 3000 K	1473.8	14.5 W	80	9.50
	139-2004	LED-6/12W / 700 mA - 4000 K	1575.5	14.5 W	80	9.50
	139-2013	LED-6/18W / 1050 mA - 3000 K	2185.4	21 W	80	9.50
	139-2014	LED-6/18W / 1050 mA - 4000 K	2287	21 W	80	9.50
	139-2028	LED-6/26W / 1400 mA - 3000 K	2711.6	29 W	80	9.50

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Luminaire Type

LL-F3


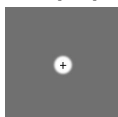
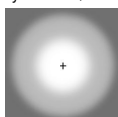
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FLC220 LED Floodlights

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Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
	139-2029	LED-6/26W / 1400 mA - 4000 K	2834.8	29 W	80	9.50
	139-2224	LED-6/26W / 1400 mA - 2700K	2563.7	29 W	80	9.50
	139-2245	LED-6/18W / 1050 mA - 2700 K	2083.7	21 W	80	9.50
	139-2248	LED-6/12W / 700 mA - 2700 K	1372.2	14.5 W	80	9.50
symmetric, very narrow beam [VN]	139-2005	LED-6/12W / 700 mA - 3000 K	1559.6	14.5 W	80	9.50
	139-2006	LED-6/12W / 700 mA - 4000 K	1667.2	14.5 W	80	9.50
	139-2015	LED-6/18W / 1050 mA - 3000 K	2312.6	21 W	80	9.50
	139-2016	LED-6/18W / 1050 mA - 4000 K	2420.1	21 W	80	9.50
	139-2030	LED-6/26W / 1400 mA - 3000 K	2869.2	29 W	80	9.50
	139-2031	LED-6/26W / 1400 mA - 4000 K	2999.6	29 W	80	9.50
	139-2261	LED-6/12W / 700 mA - 2700 K	1452.1	14.5 W	80	9.50
	139-2269	LED-6/18W / 1050 mA - 2700 K	2205	21 W	80	9.50
	139-2276	LED-6/26W / 1400 mA - 2700K	2712.7	29 W	80	9.50
symmetric, very narrow beam, 'sharp cut-off' [VNS]	139-2007	LED-6/12W / 700 mA - 3000 K	1234.8	14.5 W	80	9.50
	139-2008	LED-6/12W / 700 mA - 4000 K	1384.4	14.5 W	80	9.50
	139-2017	LED-6/18W / 1050 mA - 3000 K	1774.2	21 W	80	9.50
	139-2018	LED-6/18W / 1050 mA - 4000 K	1989.3	21 W	80	9.50
	139-2032	LED-6/26W / 1400 mA - 3000 K	2203.5	29 W	80	9.50
	139-2033	LED-6/26W / 1400 mA - 4000 K	2467.7	29 W	80	9.50
	139-2262	LED-6/12W / 700 mA - 2700 K	1160.4	14.5 W	80	9.50
	139-2270	LED-6/18W / 1050 mA - 2700 K	1666.7	21 W	80	9.50
	139-2277	LED-6/26W / 1400 mA - 2700 K	2067.9	29 W	80	9.50
symmetric, wide beam [W]	139-1999	LED-6/12W / 700 mA - 3000 K	1492	14.5 W	80	9.50
	139-2000	LED-6/12W / 700 mA - 4000 K	1594.9	14.5 W	80	9.50
	139-2009	LED-6/18W / 1050 mA - 3000 K	2212.3	21 W	80	9.50
	139-2010	LED-6/18W / 1050 mA - 4000 K	2315.2	21 W	80	9.50
	139-2024	LED-6/26W / 1400 mA - 3000 K	2744.9	29 W	80	9.50
	139-2025	LED-6/26W / 1400 mA - 4000 K	2869.7	29 W	80	9.50
	139-2186	LED-6/26W / 1400 mA - 2700K	2675.4	29 W	80	9.50
	139-2243	LED-6/18W / 1050 mA - 2700 K	2109.4	21 W	80	9.50
	139-2246	LED-6/12W / 700 mA - 2700 K	1389.1	14.5 W	80	9.50
wallwash	139-2001+139-2035-AP	LED-6/12W / 700 mA - 3000 K	1285.2	14.5 W	80	9.48
	139-2002+139-2035-AP	LED-6/12W / 700 mA - 4000 K	1373.8	14.5 W	80	9.48

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FLC220 LED Floodlights

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Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
	139-2011+139-2035-AP	LED-6/18W / 1050 mA - 3000 K	1905.6	21 W	80	9.48
	139-2012+139-2035-AP	LED-6/18W / 1050 mA - 4000 K	1994.3	21 W	80	9.48
	139-2026+139-2035-AP	LED-6/26W / 1400 mA - 3000 K	2364.4	29 W	80	9.48
	139-2027+139-2035-AP	LED-6/26W / 1400 mA - 4000 K	2471.8	29 W	80	9.48
	139-2187+139-2035-AP	LED-6/26W / 1400 mA - 2700K	2235.4	29 W	80	9.48
	139-2244+139-2035-AP	LED-6/18W / 1050 mA - 2700 K	1817	21 W	80	9.48
	139-2247+139-2035-AP	LED-6/12W / 700 mA - 2700 K	1196.6	14.5 W	80	9.50

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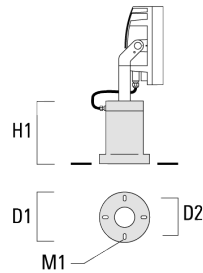
Floodlights

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Mounting Accessories

Short post EM

Description	Part ID	D1	D2	H1	M1	Weight (lb)
EM1-M16 AL - Single Cable Entry	270-9038	6.3	5.12	7.87"	0.35"	4.85 lbs



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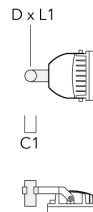
FLC220 LED

Floodlights

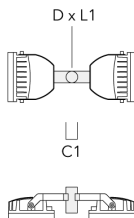
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Floodlight mounting bracket TA

Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA1 Mounting bracket, single (Ø 4.25 x 8)	147-0096		5.12	4.25 x 8	4.25	16.53	108 x 200



TA2 Mounting bracket, double (Ø 4.25 x 8)	147-0097		5.12	4.25 x 8	4.25	16.53	108 x 200
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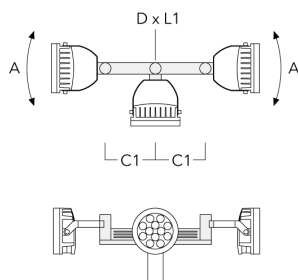
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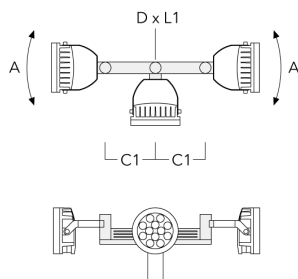
FLC220 LED **Floodlights**

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Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA3 Mounting bracket, triple (Ø 3.50 x 8)	147-0025	±90°	25.59	3.50 x 8	3.5	39.46	89 x 200



TA3 Mounting bracket, triple (Ø 4.25 x 8)	147-0098	±90°	25.59"	4.25 x 8		53.35 lbs	108 x 200
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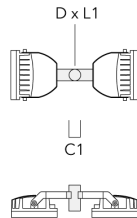
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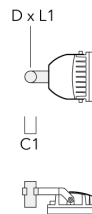
FLC220 LED **Floodlights**

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Description	Part ID	A	C1	D × L1	L	Weight (lb)	D × S
TA2 Mounting bracket, double (Ø 3 x 8)	147-0024		5.12	3 x 8	2.99	4.2 lbs	76 x 200



TA1 Mounting bracket, single (Ø 3 x 8)	147-0023		5.12	3 x 8	2.99	4.19	76 x 200
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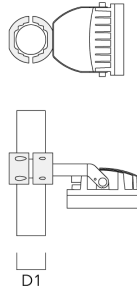
FLC220 LED

Floodlights

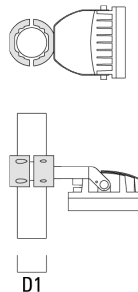
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Pole clamp TS

Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 4.0"-4.5")	147-0526	4.0-4.50	3.53	102-114



TS1-2/M12 Pole clamp, single (Ø 4.5"-5.25")	147-0544	114-133	3.75	114-133
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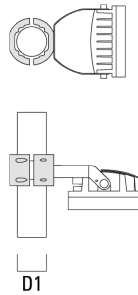
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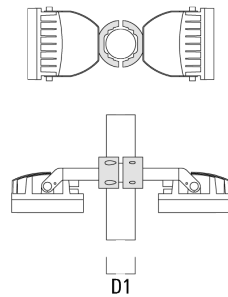
FLC220 LED
Floodlights

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Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 3"-3.5")	147-0543	3.0-3.50	3.31	76-89



TS2-2/M12 Pole clamp, double (Ø 3"-3.5")	147-0545	3.0"-3.5"	3.09 lbs	76-89
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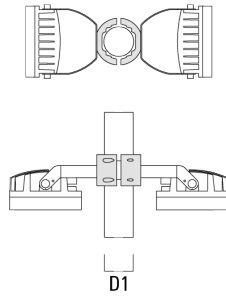
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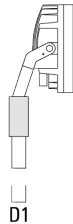
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Description	Part ID	D1	Weight (lb)	D
TS2-2/M16 Pole clamp, double (Ø 4.5"-5.25")	147-0546	4.50-5.25	3.53	114-133



Pole top caps KF

Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-60/M16 Spigot Cap (Ø 2.36")	310-9120	2.36	2.36 x 4	4.4 lbs	60 x 100



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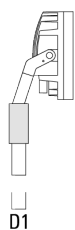
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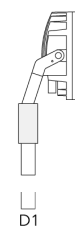
FLC220 LED
Floodlights

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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-76/M16 Spigot Cap (Ø 3.0")	310-9121	3	3 x 4	1.10 lbs	76 x 100



KF16-89/M16 Spigot Cap (Ø 3.5")	300-0734	3.50	3.5 x 3	1.10 lbs	89
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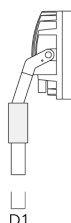
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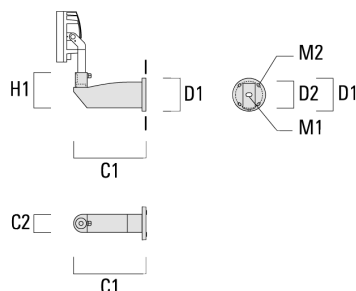
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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-108/M16 Spigot Cap (Ø 4.25")	300-0735	4.25	4.25 x 3	4.4 lbs	108



Wall Mount Bracket WMB

Description	Part ID	C1	C2	D1	D2	H1	M1	M2	Weight (lb)
WMB200 Wall mount bracket	147-6015	20.28	4.72	9.25	7.88	11.34	1.05	0.47	20.0 lbs



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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F3

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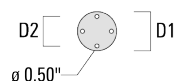
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FLC220 LED
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Surface Mount Canopy SMC

Description	Part ID	D1	D2	Weight (lb)
SMC-200	147-6915	10.83	9.25	15.4 lbs



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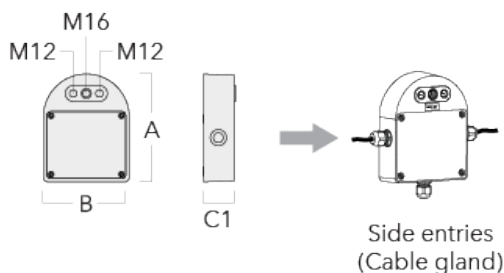
FLC220 LED

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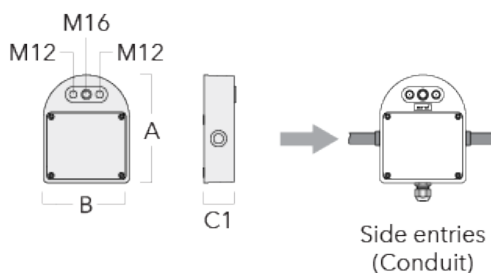
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Junction box

Description	Part ID	Additional information	A	B	C1	Weight (lb)
Junction box JB20 - Cable side entries	310-9013	Junction boxes are made from marine-grade, die-cast aluminium alloy. IK10. IP66. For side entries and suitable to be used with cable glands.	7.09	5.63	2.01	2.25



Junction box JB20 - Conduit side entries	310-9014	Junction boxes are made from marine-grade, die-cast aluminium alloy. IK10. IP66. For side entries and suitable to be used with conduits.	7.09	5.63	2.01	2.25
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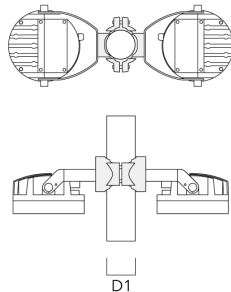
FLC220 LED

Floodlights

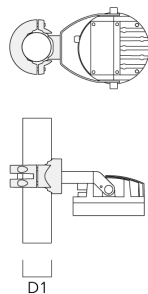
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Pole clamp PC

Description	Part ID	D1	Weight (lb)
PC2 76-89/60 Pole clamp, double (Ø 3"-3.5")	139-2703	3.0-3.50	2.20



PC1 76-89/60 Pole clamp, single (Ø 3"-3.5")	139-2702	3.0-3.50	2.20
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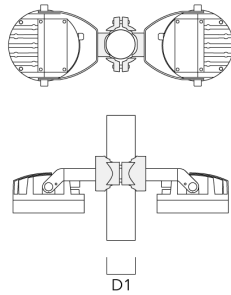
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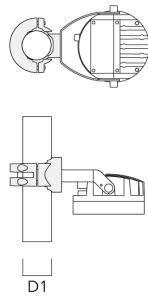
FLC220 LED **Floodlights**

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Description	Part ID	D1	Weight (lb)
PC2 102-114/60 Pole clamp, double (Ø 4"-4.5")	139-2707	4.0-4.50	2.65



PC1 102-114/60 Pole clamp, single (Ø 4"-4,5")	139-2706	4.0-4.50	2.65
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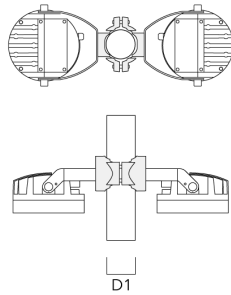
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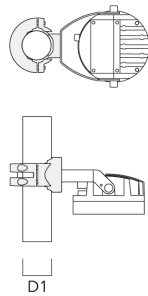
FLC220 LED **Floodlights**

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Description	Part ID	D1	Weight (lb)
PC2 114-133/60 Pole clamp, double (Ø 4.5"-5.25")	139-2709	4.5-5.25	3.10



PC1 114-133/60 Pole clamp, single (Ø 4.5"-5.25")	139-2708	4.5-5.25	3.10
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Luminaire Type

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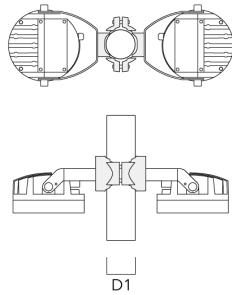
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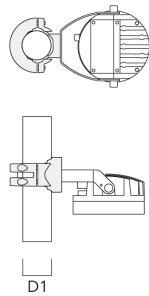
Floodlights

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Description	Part ID	D1	Weight (lb)
PC2 82-109/60 Pole clamp, double (Ø 3.25"-4.25")	139-2705	3.20-4.30	2.40



PC1 82-109/60 Pole camp, single (Ø 3.25"-4.3")	139-2704	3.20-4.30	2.40
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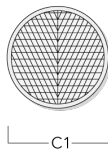
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Optical Accessories

Wallwash lens

Description	Part ID	C1
IO-20-FLC220-LED	139-2035	5.75



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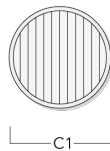
FLC220 LED

Floodlights

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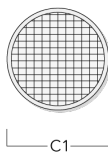
Linear spread lens

Description	Part ID	C1
IO-180-FLC220-LED	139-2036	5.75



Softening Lens

Description	Part ID	C1
IO-360-FLC220-LED	139-2037	5.75



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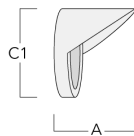
Honeycomb louvre

Description	Part ID	C1
IW-FLC220-LED	139-2034	5.43



Glare shield

Description	Part ID	A	C1
ES-FLC220-LED	139-1986	4.92	7.48



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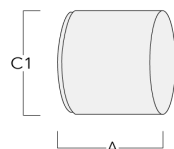
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Snoot

Description	Part ID	A	C1
ET-FLC220-LED	139-1987	4.92	7.48



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Luminaire Type

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Description

3G Vibration Certified.

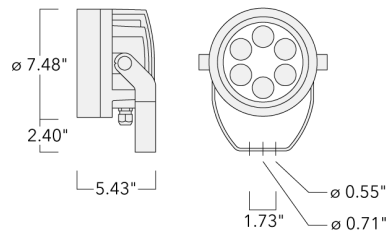
IP66. Class I. IK07. Marine-grade, die-cast aluminum alloy. 5CE superior corrosion protection including PCS hardware. Silicone CCG® Controlled Compression Gasket. Safety glass lens. One cable gland, second gland for through wiring on request. CAD-optimized optics for superior illumination and glare control. Integral driver, thermally separated. OLC® One LED Concept. Factory-installed LED circuit board. 0-10V Dimming comes standard with luminaire.

Optional 2200 K version available. To be specified at time of ordering.

A maximum of one internal optical accessory.

Specify product with 7 Digit product code - Finish Color. Accessories, such as mounting, optical, and electrical, must be specified separately.

Example: XXX-XXXX-9004 (Black)
+ XXX-XXXX (Accessory 1)



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Project

Luminaire Type

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Torrance, CA

LL-F4

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FLC220 LED

Floodlights

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Specifications

Material description

Body	Marine-grade, die-cast aluminium alloy
Lens	Safety glass lens
Colors	<div><div></div> RAL9004 Black</div> <div><div></div> RAL9007 Grey Metallic</div> <div><div></div> RAL9016 White</div> <div><div></div> RAL8019 Dark Bronze</div>
Gasket	Silicone CCG® Controlled Compression Gasket
Fasteners	PCS Polymer Coated Stainless Steel Hardware
Ingress protection	IP66
Impact resistance	IK07
Corrosion resistance	5CE
Windage	0.372

Electrical description

Power supply	Integral [ECG] electronic driver 120V-277V. 0-10V dimmable, to be specified with order.
Driver / Ballast	ECG in thermally-separated compartment
Surge protection	Integral 10kV Surge Protector

Additional information

Lifetime	Ta=25°/40° L90B10 > 90000h
Lead Time	This is a new product release and may have an extended lead time.
Listings	ETL, UL-1598, CSA-C22.2#250.0. Suitable for Wet Locations. Meets ANSI C136.31 - 3G Vibration Rating for Bridge and Overpass Applications.

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Luminaire Type

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FLC220 LED

Floodlights

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Options

Light distribution



symmetric, wide beam [W]



symmetric, medium beam [M]



symmetric, narrow beam [N]



symmetric, very narrow beam [VN]



symmetric, very narrow beam, 'sharp cut-off' [VNS]



wallwash



linear spread, very narrow beam [VN]



linear spread, very narrow beam, 'sharp cut-off'

Color temperature



3000 K



4000 K



2700 K

Nominal Watt

0 W

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Luminaire Type

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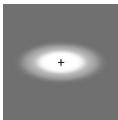
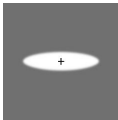


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FLC220 LED

Floodlights

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Configurations

Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
linear spread, very narrow beam [VN] 	139-2005+139-2036	LED-6/12W / 700 mA - 3000 K	1487	14.5 W	80	9.48
	139-2006+139-2036	LED-6/12W / 700 mA - 4000 K	1589.5	14.5 W	80	9.48
	139-2015+139-2036	LED-6/18W / 1050 mA - 3000 K	2204.8	21 W	80	9.48
	139-2016+139-2036	LED-6/18W / 1050 mA - 4000 K	2307.4	21 W	80	9.48
	139-2030+139-2036	LED-6/26W / 1400 mA - 3000 K	2712.7	29 W	80	9.48
	139-2031+139-2036	LED-6/26W / 1400 mA - 4000 K	2836	29 W	80	9.48
	139-2261+139-2036	LED-6/12W / 700 mA - 2700 K	1384.4	14.5 W	80	9.48
	139-2269+139-2036	LED-6/18W / 1050 mA - 2700 K	2102.3	21 W	80	9.48
	139-2276+139-2036	LED-6/26W / 1400 mA - 2700K	2564.7	29 W	80	9.48
linear spread, very narrow beam, 'sharp cut-off' 	139-2007+139-2036	LED-6/12W / 700 mA - 3000 K	1203.4	14.5 W	80	9.48
	139-2008+139-2036	LED-6/12W / 700 mA - 4000 K	1349.3	14.5 W	80	9.48
	139-2017+139-2036	LED-6/18W / 1050 mA - 3000 K	1729.2	21 W	80	9.48
	139-2018+139-2036	LED-6/18W / 1050 mA - 4000 K	1938.8	21 W	80	9.48
	139-2032+139-2036	LED-6/26W / 1400 mA - 3000 K	2128.7	29 W	80	9.48
	139-2033+139-2036	LED-6/26W / 1400 mA - 4000 K	2384	29 W	80	9.48
	139-2262+139-2036	LED-6/12W / 700 mA - 2700 K	1131	14.5 W	80	9.48
	139-2270+139-2036	LED-6/18W / 1050 mA - 2700 K	1624.4	21 W	80	9.50
	139-2277+139-2036	LED-6/26W / 1400 mA - 2700 K	1997.7	29 W	80	9.48
symmetric, medium beam [M] 	139-2001	LED-6/12W / 700 mA - 3000 K	1533.6	14.5 W	80	9.50
	139-2002	LED-6/12W / 700 mA - 4000 K	1639.3	14.5 W	80	9.50
	139-2011	LED-6/18W / 1050 mA - 3000 K	2273.9	21 W	80	9.50
	139-2012	LED-6/18W / 1050 mA - 4000 K	2379.6	21 W	80	9.50
	139-2026	LED-6/26W / 1400 mA - 3000 K	2821.4	29 W	80	9.50
	139-2027	LED-6/26W / 1400 mA - 4000 K	2949.6	29 W	80	9.50
	139-2187	LED-6/26W / 1400 mA - 2700K	2667.5	29 W	80	9.50
	139-2244	LED-6/18W / 1050 mA - 2700 K	2168.1	21 W	80	9.50
	139-2247	LED-6/12W / 700 mA - 2700 K	1427.8	14.5 W	80	9.50
symmetric, narrow beam [N] 	139-2003	LED-6/12W / 700 mA - 3000 K	1473.8	14.5 W	80	9.50
	139-2004	LED-6/12W / 700 mA - 4000 K	1575.5	14.5 W	80	9.50
	139-2013	LED-6/18W / 1050 mA - 3000 K	2185.4	21 W	80	9.50
	139-2014	LED-6/18W / 1050 mA - 4000 K	2287	21 W	80	9.50
	139-2028	LED-6/26W / 1400 mA - 3000 K	2711.6	29 W	80	9.50

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Luminaire Type

LL-F4


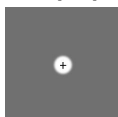
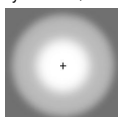
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FLC220 LED Floodlights

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Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
	139-2029	LED-6/26W / 1400 mA - 4000 K	2834.8	29 W	80	9.50
	139-2224	LED-6/26W / 1400 mA - 2700K	2563.7	29 W	80	9.50
	139-2245	LED-6/18W / 1050 mA - 2700 K	2083.7	21 W	80	9.50
	139-2248	LED-6/12W / 700 mA - 2700 K	1372.2	14.5 W	80	9.50
symmetric, very narrow beam [VN]	139-2005	LED-6/12W / 700 mA - 3000 K	1559.6	14.5 W	80	9.50
	139-2006	LED-6/12W / 700 mA - 4000 K	1667.2	14.5 W	80	9.50
	139-2015	LED-6/18W / 1050 mA - 3000 K	2312.6	21 W	80	9.50
	139-2016	LED-6/18W / 1050 mA - 4000 K	2420.1	21 W	80	9.50
	139-2030	LED-6/26W / 1400 mA - 3000 K	2869.2	29 W	80	9.50
	139-2031	LED-6/26W / 1400 mA - 4000 K	2999.6	29 W	80	9.50
	139-2261	LED-6/12W / 700 mA - 2700 K	1452.1	14.5 W	80	9.50
	139-2269	LED-6/18W / 1050 mA - 2700 K	2205	21 W	80	9.50
	139-2276	LED-6/26W / 1400 mA - 2700K	2712.7	29 W	80	9.50
symmetric, very narrow beam, 'sharp cut-off' [VNS]	139-2007	LED-6/12W / 700 mA - 3000 K	1234.8	14.5 W	80	9.50
	139-2008	LED-6/12W / 700 mA - 4000 K	1384.4	14.5 W	80	9.50
	139-2017	LED-6/18W / 1050 mA - 3000 K	1774.2	21 W	80	9.50
	139-2018	LED-6/18W / 1050 mA - 4000 K	1989.3	21 W	80	9.50
	139-2032	LED-6/26W / 1400 mA - 3000 K	2203.5	29 W	80	9.50
	139-2033	LED-6/26W / 1400 mA - 4000 K	2467.7	29 W	80	9.50
	139-2262	LED-6/12W / 700 mA - 2700 K	1160.4	14.5 W	80	9.50
	139-2270	LED-6/18W / 1050 mA - 2700 K	1666.7	21 W	80	9.50
	139-2277	LED-6/26W / 1400 mA - 2700 K	2067.9	29 W	80	9.50
symmetric, wide beam [W]	139-1999	LED-6/12W / 700 mA - 3000 K	1492	14.5 W	80	9.50
	139-2000	LED-6/12W / 700 mA - 4000 K	1594.9	14.5 W	80	9.50
	139-2009	LED-6/18W / 1050 mA - 3000 K	2212.3	21 W	80	9.50
	139-2010	LED-6/18W / 1050 mA - 4000 K	2315.2	21 W	80	9.50
	139-2024	LED-6/26W / 1400 mA - 3000 K	2744.9	29 W	80	9.50
	139-2025	LED-6/26W / 1400 mA - 4000 K	2869.7	29 W	80	9.50
	139-2186	LED-6/26W / 1400 mA - 2700K	2675.4	29 W	80	9.50
	139-2243	LED-6/18W / 1050 mA - 2700 K	2109.4	21 W	80	9.50
	139-2246	LED-6/12W / 700 mA - 2700 K	1389.1	14.5 W	80	9.50
wallwash	139-2001+139-2035-AP	LED-6/12W / 700 mA - 3000 K	1285.2	14.5 W	80	9.48
	139-2002+139-2035-AP	LED-6/12W / 700 mA - 4000 K	1373.8	14.5 W	80	9.48

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Luminaire Type

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Light distribution	Part ID	Light source	Delivered lumens	Rated input power	CRI	Weight (lb)
	139-2011+139-2035-AP	LED-6/18W / 1050 mA - 3000 K	1905.6	21 W	80	9.48
	139-2012+139-2035-AP	LED-6/18W / 1050 mA - 4000 K	1994.3	21 W	80	9.48
	139-2026+139-2035-AP	LED-6/26W / 1400 mA - 3000 K	2364.4	29 W	80	9.48
	139-2027+139-2035-AP	LED-6/26W / 1400 mA - 4000 K	2471.8	29 W	80	9.48
	139-2187+139-2035-AP	LED-6/26W / 1400 mA - 2700K	2235.4	29 W	80	9.48
	139-2244+139-2035-AP	LED-6/18W / 1050 mA - 2700 K	1817	21 W	80	9.48
	139-2247+139-2035-AP	LED-6/12W / 700 mA - 2700 K	1196.6	14.5 W	80	9.50

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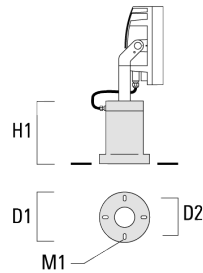
Floodlights

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Mounting Accessories

Short post EM

Description	Part ID	D1	D2	H1	M1	Weight (lb)
EM1-M16 AL - Single Cable Entry	270-9038	6.3	5.12	7.87"	0.35"	4.85 lbs



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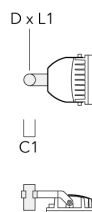
FLC220 LED

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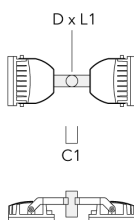
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Floodlight mounting bracket TA

Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA1 Mounting bracket, single (Ø 4.25 x 8)	147-0096		5.12	4.25 x 8	4.25	16.53	108 x 200



TA2 Mounting bracket, double (Ø 4.25 x 8)	147-0097		5.12	4.25 x 8	4.25	16.53	108 x 200
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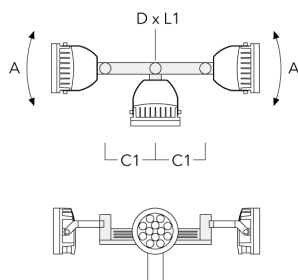
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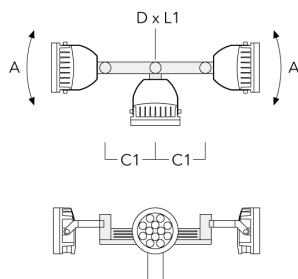
FLC220 LED **Floodlights**

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Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA3 Mounting bracket, triple (Ø 3.50 x 8)	147-0025	±90°	25.59	3.50 x 8	3.5	39.46	89 x 200



TA3 Mounting bracket, triple (Ø 4.25 x 8)	147-0098	±90°	25.59"	4.25 x 8		53.35 lbs	108 x 200
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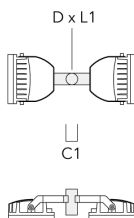
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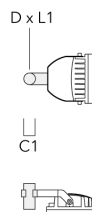
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Description	Part ID	A	C1	D x L1	L	Weight (lb)	D x S
TA2 Mounting bracket, double (Ø 3 x 8)	147-0024		5.12	3 x 8	2.99	4.2 lbs	76 x 200



TA1 Mounting bracket, single (Ø 3 x 8)	147-0023		5.12	3 x 8	2.99	4.19	76 x 200
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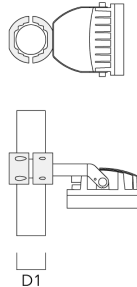
FLC220 LED

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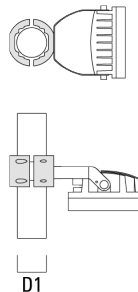
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Pole clamp TS

Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 4.0"-4.5")	147-0526	4.0-4.50	3.53	102-114



TS1-2/M12 Pole clamp, single (Ø 4.5"-5.25")	147-0544	114-133	3.75	114-133
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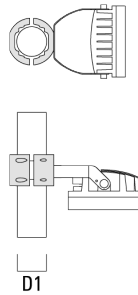
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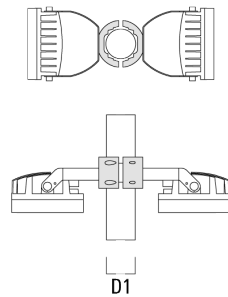
FLC220 LED
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Description	Part ID	D1	Weight (lb)	D
TS1-2/M12 Pole clamp, single (Ø 3"-3.5")	147-0543	3.0-3.50	3.31	76-89



TS2-2/M12 Pole clamp, double (Ø 3"-3.5")	147-0545	3.0"-3.5"	3.09 lbs	76-89
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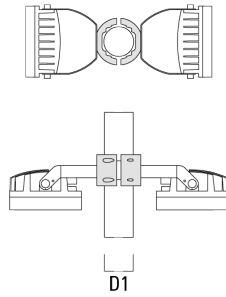
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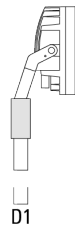
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Description	Part ID	D1	Weight (lb)	D
TS2-2/M16 Pole clamp, double (Ø 4.5"-5.25")	147-0546	4.50-5.25	3.53	114-133



Pole top caps KF

Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-60/M16 Spigot Cap (Ø 2.36")	310-9120	2.36	2.36 x 4	4.4 lbs	60 x 100



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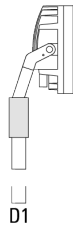
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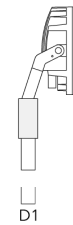
FLC220 LED
Floodlights

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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-76/M16 Spigot Cap (Ø 3.0")	310-9121	3	3 x 4	1.10 lbs	76 x 100



KF16-89/M16 Spigot Cap (Ø 3.5")	300-0734	3.50	3.5 x 3	1.10 lbs	89
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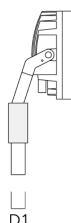
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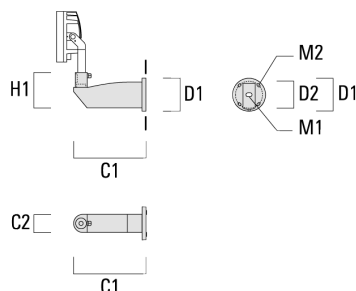
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Description	Part ID	D1	D × L1	Weight (lb)	D
KF16-108/M16 Spigot Cap (Ø 4.25")	300-0735	4.25	4.25 x 3	4.4 lbs	108



Wall Mount Bracket WMB

Description	Part ID	C1	C2	D1	D2	H1	M1	M2	Weight (lb)
WMB200 Wall mount bracket	147-6015	20.28	4.72	9.25	7.88	11.34	1.05	0.47	20.0 lbs



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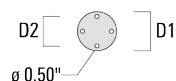
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Surface Mount Canopy SMC

Description	Part ID	D1	D2	Weight (lb)
SMC-200	147-6915	10.83	9.25	15.4 lbs



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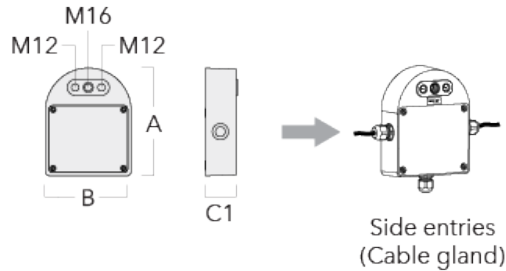
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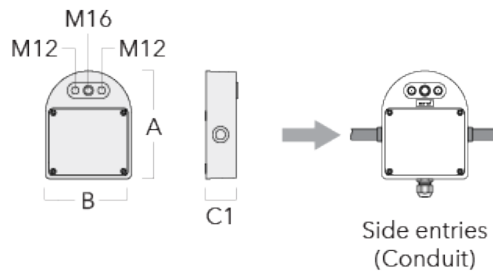
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Junction box

Description	Part ID	Additional information	A	B	C1	Weight (lb)
Junction box JB20 - Cable side entries	310-9013	Junction boxes are made from marine-grade, die-cast aluminium alloy. IK10. IP66. For side entries and suitable to be used with cable glands.	7.09	5.63	2.01	2.25



Junction box JB20 - Conduit side entries	310-9014	Junction boxes are made from marine-grade, die-cast aluminium alloy. IK10. IP66. For side entries and suitable to be used with conduits.	7.09	5.63	2.01	2.25
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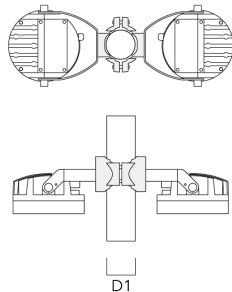
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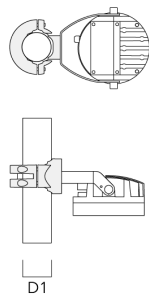
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Pole clamp PC

Description	Part ID	D1	Weight (lb)
PC2 76-89/60 Pole clamp, double (Ø 3"-3.5")	139-2703	3.0-3.50	2.20



PC1 76-89/60 Pole clamp, single (Ø 3"-3.5")	139-2702	3.0-3.50	2.20
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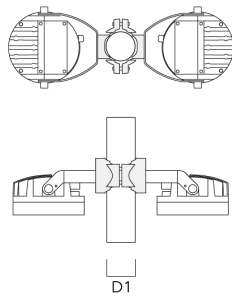
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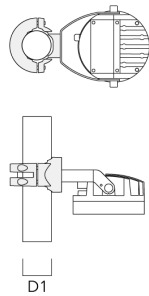
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Description	Part ID	D1	Weight (lb)
PC2 102-114/60 Pole clamp, double (Ø 4"-4.5")	139-2707	4.0-4.50	2.65



PC1 102-114/60 Pole clamp, single (Ø 4"-4,5")	139-2706	4.0-4.50	2.65
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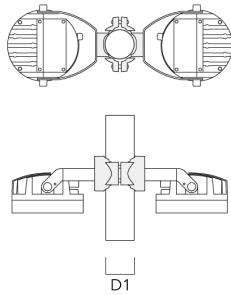
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FLC220 LED

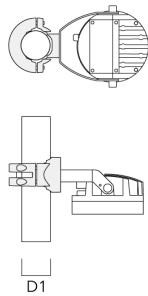
Floodlights

we-ef

Description	Part ID	D1	Weight (lb)
PC2 114-133/60 Pole clamp, double (Ø 4.5"-5.25")	139-2709	4.5-5.25	3.10



PC1 114-133/60 Pole clamp, single (Ø 4.5"-5.25")	139-2708	4.5-5.25	3.10
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WE-EF LIGHTING USA, LLC

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customersupport.usa@we-ef.com - <https://we-ef.com/us>
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March 22, 2026

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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F4

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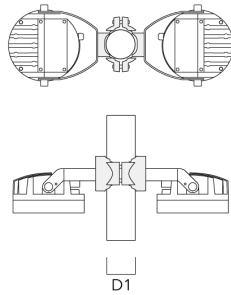
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SEATTLE | 107 Spring Street Seattle WA 98104 USA +1 206 876 8555
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FLC220 LED

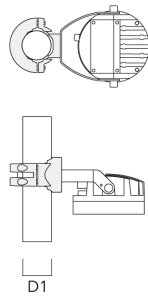
Floodlights

we-ef

Description	Part ID	D1	Weight (lb)
PC2 82-109/60 Pole clamp, double (Ø 3.25"-4.25")	139-2705	3.20-4.30	2.40



PC1 82-109/60 Pole camp, single (Ø 3.25"-4.3")	139-2704	3.20-4.30	2.40
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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F4

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FLC220 LED

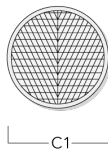
Floodlights

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Optical Accessories

Wallwash lens

Description	Part ID	C1
IO-20-FLC220-LED	139-2035	5.75



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March 22, 2026

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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F4

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FLC220 LED

Floodlights

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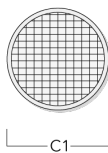
Linear spread lens

Description	Part ID	C1
IO-180-FLC220-LED	139-2036	5.75



Softening Lens

Description	Part ID	C1
IO-360-FLC220-LED	139-2037	5.75



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March 22, 2026

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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F4

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FLC220 LED

Floodlights

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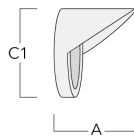
Honeycomb louvre

Description	Part ID	C1
IW-FLC220-LED	139-2034	5.43



Glare shield

Description	Part ID	A	C1
ES-FLC220-LED	139-1986	4.92	7.48



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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F4

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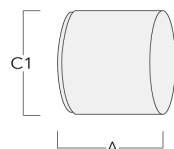
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SEATTLE | 107 Spring Street Seattle WA 98104 USA +1 206 876 8555
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FLC220 LED
Floodlights

we-ef

Snoot

Description	Part ID	A	C1
ET-FLC220-LED	139-1987	4.92	7.48



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Project

Luminaire Type

WWII Monument

Torrance, CA

LL-F4

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LOS ANGELES | 5855 Green Valley Circle Ste 306 Culver City, CA 90230 USA +1 310 715 8333
SEATTLE | 107 Spring Street Seattle WA 98104 USA +1 206 876 8555
www.oculuslightstudio.com

SPECIFICATIONS

DESCRIPTION:

High output LED adjustable accent fixture. Suitable for wet/damp/dry location installations.

MATERIAL:

Standard overall material is 6061 aluminum.

FINISH:

AA - Anodized Satin Aluminum
AP - Powder Coat Aluminum
BK - Powder Coat Black
BZ - Powder Coat Bronze
WT - Powder Coat White

LED OPTIONS:

Integral high output Xicato LED module,

L30 - 5.4W, 720 Lumens (3000K)

L40 - 11.4W, 1275 Lumens (3000K)

Color Temperature CCT

27 - 2700K CCT

30 - 3000K CCT

35 - 3500K CCT

40 - 4000K CCT

IES TM-30: Rf 78, Rg 101

Reflector, Field Replaceable

NF - Narrow Flood, 20°

FL - Flood, 40°

WFL - Wide Flood, 60°

VOLTAGE:

Requires remote LED driver. Leading edge/trailing edge dimmable constant current remote LED Driver included. Dimmable only in 120V. See driver options.

120-277 - 120-277V LED driver

DRIVER OPTIONS:

Fixture includes HL-RD remote LED driver enclosure (3R rated stainless steel enclosure) standard. Driver options available in place of HL-RD for direct burial, surface, ground and wall mounting available.

H-POD-LED-L** - Remote direct burial driver.

HLD-CBB-L** - Composite burial box for driver w/fixture mount.

SMED-L** - Surface mount driver canopy.

WMED-L** - Wall mount driver canopy.

MOUNTING:

Fixture is designed with a 1/2"-NPS adjustable mounting stem.

OPTIONS:

Glare shield

GL-920 - Angled, aluminum

GL-921 - Straight, aluminum

Lenses/Louvers/Color Filters

LA-1-920 - Hexcell Louver (Black)

LA-2-920 - Prismatic lens

LA-3-920 - Linear spread lens

LA-4-920 - Soft focus lens (diffused)

LA-5-920 - Moonlight lens

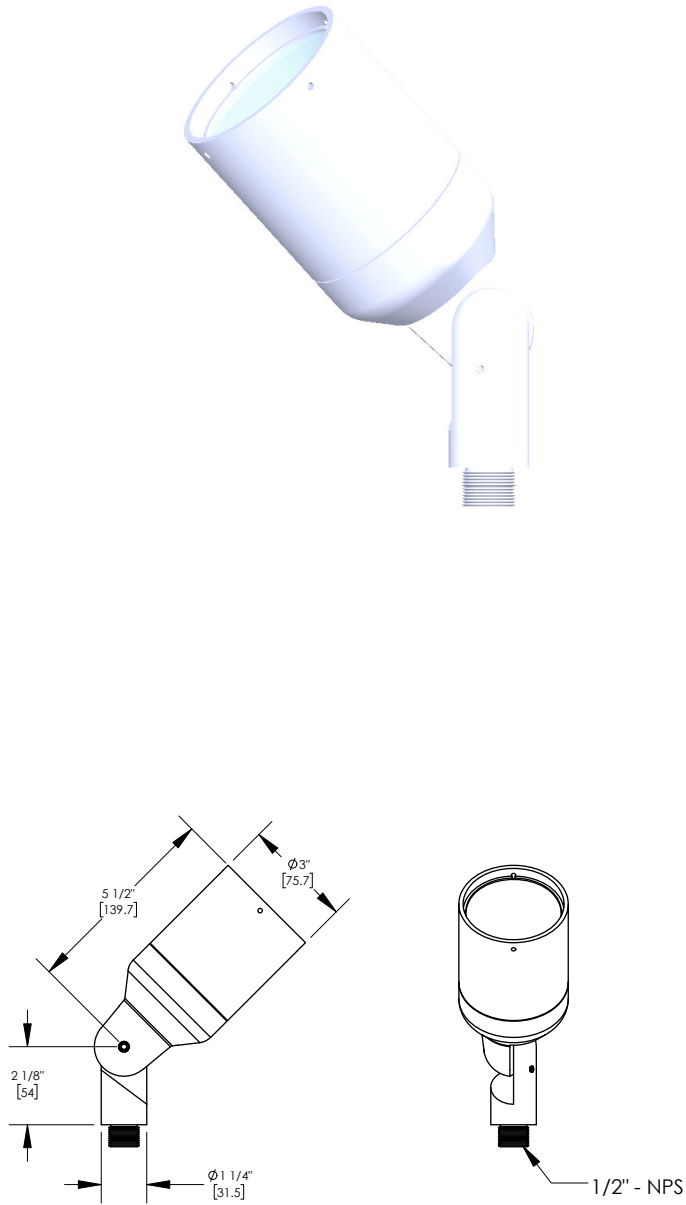
LA-6-920 - Blue lens

See fixture accessories for more information.

RATING:

Wet/damp/dry location.

MADE IN THE USA



PROJECT:

APPROVED:

NOTE:

TYPE:

HEVI LITE, INC.

9714 Variel Ave, Chatsworth, CA 91311
Tel., (818) 341-8091 - Fax (818) 998-1986
Web Site <http://www.hevilite.com>

CATALOG NUMBER:

HL-918

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Project

WWII Monument

Torrance, CA

OCULUS LIGHT STUDIO

Page 1 of 2

Luminaire Type

LL1

LOS ANGELES | 5855 Green Valley Circle Ste 306 Culver City, CA 90230 USA +1 310 715 8333
SEATTLE | 107 Spring Street Seattle WA 98104 USA +1 206 876 8555
www.oculuslightstudio.com

SPECIFICATIONS

DESCRIPTION:
Stainless steel triple prong ground mounting spike, for low voltage applications. Suitable for wet/damp/dry location installations.

MATERIAL:
Standard overall material stainless steel.
GM-3 - Machined Stainless Steel

FINISH:
BZ - Powder Coat Bronze
N - Natural, Stainless Steel

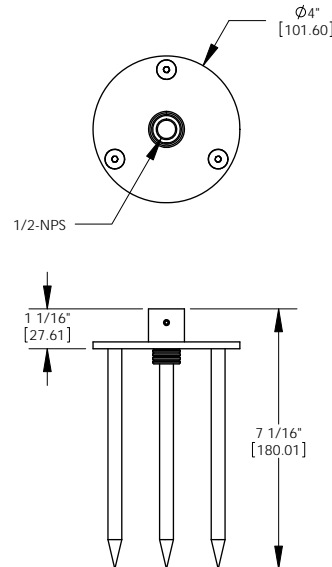
VOLTAGE:
Suitable for low voltage (12V) fixtures.

MOUNTING:
Spike has (1) 1/2-NPS mount.

SAMPLE ORDER SPECIFICATION:
GM-3-AA

RATING:
Wet/damp/dry location.

MADE IN THE USA



ORDER SPECIFICATION: _____ Fixture _____ Finish _____ Lamping _____ Voltage _____ Options/Access. _____

PROJECT:

APPROVED:

NOTE:

TYPE:

HEVI LITE, INC.
9714 Variel Ave, Chatsworth, CA 91311
Tel., (818) 341-8091 - Fax (818) 998-1986
Web Site <http://www.hevilight.com>

CATALOG NUMBER:

GM-3

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Project

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Torrance, CA

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Luminaire Type

LL1

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SEATTLE | 107 Spring Street Seattle WA 98104 USA +1 206 876 8555
www.oculuslightstudio.com

DIVISION 31

EARTHWORK

Section 31 10 00 – Site Clearing

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Protection of existing trees indicated to remain.
 - 2. Removal of trees and other vegetation.
 - 3. Topsoil stripping and stockpiling.
 - 4. Clearing and grubbing.
 - 5. Removing above-grade improvements.
 - 6. Removing below-grade improvements.
- B. Related Sections:
 - 1. "Temporary Facilities and Controls" Section for temporary utility services, construction and support facilities, and security and protection facilities.
 - 2. "Execution" Section for field engineering and surveying.
 - 3. "Construction Waste Management and Disposal" and "Sustainable Design Requirements" Section for additional LEED requirements.

1.3 PROJECT CONDITIONS

- A. Traffic: Conduct site-clearing operations to ensure minimum interference with roads, streets, walks, and other adjacent occupied or used facilities. Do not close or obstruct streets, walks, or other occupied or used facilities without permission from authorities having jurisdiction.
- B. Protection of Existing Improvements: Provide protections necessary to prevent damage to existing improvements indicated to remain in place.
 - 1. Protect improvements on adjoining properties and on Owner's property.
 - 2. Restore damaged improvements to their original condition, as acceptable to property owners. The full-width of pavements damaged due to construction access and other construction-related activities shall be replaced with a structural section (pavement and base) at least equal to the adjacent existing section.
 - 3. Protect existing utility lines indicated to remain. Notify Owner immediately of any damage to or encounter with an unknown existing utility line. Immediately repair damage to existing utility lines.
- C. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place against unnecessary cutting, breaking or skinning of roots, ANY skinning or bruising of bark, smothering of trees by stockpiling construction materials or excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

1. Water trees and other vegetation to remain within limits of contract work as required to maintain their health during course of construction operations.
 2. Provide protection for roots over 1-1/2 inch in diameter that are cut during construction operations. Coat cut faces with an emulsified asphalt or other acceptable coating formulated to use on damaged plant tissues. Temporarily cover exposed roots with wet burlap to prevent roots from drying out; cover with earth as soon as possible.
 3. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations in a manner acceptable to Architect. Employ a licensed arborist to repair damage to trees and shrubs.
 4. Replace trees that cannot be repaired and restored to full-growth status, as determined by arborist.
- D. Improvements on Adjoining Property: Authority for performing removal and alteration work on property adjoining Owner's property will be obtained by Owner prior to award of contract.
1. Extent of work on adjacent property is indicated on Drawings.
- E. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises were indicated or directed.
- F. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place.
- G. Soil stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

1.4 EXISTING SERVICES

- A. General: Indicated locations are approximate; determine exact locations before commencing Work.
- B. Arrange and pay for disconnecting, removing, capping, and plugging utility services. Notify affected utility companies in advance and obtain approval before starting this Work.
- C. Place markers to indicate location of disconnected services. Identify service lines and capping locations on Project Record Documents.

PART 2 - PRODUCTS

2.1 NONE

PART 3 - EXECUTION

3.1 SITE CLEARING

- A. General: Remove shrubs, grass, and other vegetation, improvements, or obstructions, as required, to permit installation of new construction. Remove similar items elsewhere on

site or premises as specifically indicated. Removal includes digging out and off-site disposal of stumps and roots.

1. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 2. Unless specifically designated to remain, strip the upper two inches (minimum) of soil containing vegetation and root growth within the Limits of Work shown on the Drawings.
- B. Topsoil: Topsoil is defined as friable clay loam surface soil found in a depth of not less than 4 inches. Satisfactory topsoil is reasonably free of subsoil, clay lumps, stones, and other objects over 2 inches in diameter, and without weeds, roots, and other objectionable material.
1. Strip topsoil to whatever depths encountered in a manner to prevent intermingling with underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
 - a. Where existing trees are indicated to remain, leave existing topsoil in place within drip lines to prevent damage to root system.
 2. Stockpile topsoil in storage piles in areas indicated or directed. Construct storage piles to provide free drainage of surface water. Cover storage piles, if required, to prevent wind erosion. Limit height of stockpiles to 72 inches.
 3. Dispose of unsuitable or excess topsoil as specified for disposal of waste material.
- C. Clearing and Grubbing: Clear site of trees, shrubs, and other vegetation, except for those indicated to be left standing.
1. Completely remove stumps, roots, and other debris protruding through ground surface.
 2. Use only hand methods for grubbing inside drip line of trees indicated to remain.
 3. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
 - a. Place fill material in horizontal layers not exceeding 8 inches loose depth and thoroughly compact each layer and compact in accordance with the requirements specified in Division 31 Section "Earth Moving" to make the new surface conform with the existing adjacent surface of the ground.
 4. Trim trees, designated to be left standing within the cleared areas, of dead branches 1-1/2 inches or more in diameter; and trim all branches to heights and in a manner as indicated. Neatly cut limbs and branches to be trimmed close to the bole of the tree or main branches. Paint cuts more than 1-1/4 inches in diameter with specified tree-wound paint.
- D. Removal of Improvements: Remove existing above-grade and below-grade improvements as indicated and as necessary to facilitate new construction.
1. Abandonment or removal of certain underground pipe or conduits may be indicated on mechanical or electrical drawings. Removing abandoned underground piping or conduits interfering with construction are included under this Section.

3.2 DISPOSAL OF WASTE MATERIALS

- A. Burning on Owner's Property: Burning is not permitted on Owner's property.

- B. Removal from Owner's Property: Remove waste materials and unsuitable or excess topsoil from Owner's property.
- 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

Section 31 12 00 - Demolition

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Demolition and removal of buildings.
 - 2. Demolition and removal of structures.
 - 3. Demolition and removal of site improvements.
 - 4. Disconnecting, capping or sealing, and abandoning site utilities in place.
 - 5. Disconnecting, capping or sealing, and removing site utilities.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. "Cutting and Patching" Section for cutting and patching procedures for demolition operations.
 - 2. Division 1 Section "Schedules and Reports" Section for demolition schedule requirements.
 - 3. Division 1 Section "Construction Facilities and Temporary Controls" Section for temporary utilities, temporary construction and support facilities, temporary security and protection facilities, and environmental protection measures for demolition operations.
 - 4. "Contract Closeout" Section for record document requirements.
 - 5. "Selective Demolition" Section for partial demolition of a building or structure undergoing alterations and for the removal, salvage, or reuse of materials in new construction.
 - 6. "Tree Protection and Trimming" Section for protecting trees remaining on-site.
 - 7. "Site Clearing" Section for site clearing and removing above- and below-grade improvements.
 - 8. "Earth Moving" Section for soil materials, excavating, backfilling, and site grading.

1.3 DEFINITIONS

- A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the Owner's property.
- B. Remove and Salvage: Items indicated to be removed and salvaged remain the Owner's property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Owner's designated storage area.
- C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in locations indicated.
- D. Existing to Remain: Protect construction indicated to remain against damage and soiling during demolition. When permitted by the Architect, items may be removed to a suitable,

protected storage location during demolition and then cleaned and reinstalled in their original locations.

1.4 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, or otherwise indicated to remain the Owner's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.
- B. Historical items indicated remain the Owner's property. Carefully remove and salvage each item in a manner to prevent damage and deliver promptly to the Owner.
- C. Historical 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 the Owner, which may be encountered during demolition, remain the Owner's property. Carefully remove and salvage each item or object in a manner to prevent damage and deliver promptly to the Owner.
 - 1. Cooperate with Owner's archaeologist or historical adviser.

1.5 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.
- B. Proposed dust-control measures.
- C. Proposed noise-control measures.
- D. Schedule of demolition activities indicating the following:
 - 1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
 - 2. Dates for shutoff, capping, and continuation of utility services.
- E. Inventory of items to be removed and salvaged.
- F. Inventory of items to be removed by Owner.
- G. Photographs or videotape, sufficiently detailed, of existing conditions of adjoining construction and site improvements that might be misconstrued as damage caused by demolition operations.
- H. Record drawings at Project closeout according to "Contract Closeout" Section.
 - 1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.
- I. Landfill records for record purposes indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed demolition Work similar to that indicated for this Project.
- B. Regulatory Requirements: Comply with governing EPA notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- C. Pre-demolition Conference: Conduct conference at Project site to comply with pre-installation conference requirements of Division 1 Section "Project Meetings."

1.7 PROJECT CONDITIONS

- A. Buildings to be demolished will be vacated and their use discontinued before start of Work.
- B. Owner assumes no responsibility for actual condition of buildings to be demolished.
 - 1. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
- C. Asbestos: It is not expected that asbestos will be encountered in the course of this Contract. If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify the Architect and the Owner.
 - 1. Asbestos will be removed by Owner before start of Work.
- D. Asbestos: Asbestos is present in the building or structure to be demolished. A report on the presence of asbestos is on file for review and use. Examine the report to become aware of locations where asbestos is present.
 - 1. Asbestos abatement is specified elsewhere in the Contract Documents.
 - 2. Do not disturb asbestos or any material suspected of containing asbestos except under the procedures specified elsewhere in the Contract Documents.
- E. Storage or sale of removed items or materials on-site will not be permitted.

1.8 SCHEDULING

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

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. Requirements for satisfactory soil materials are specified in "Earth Moving" Section.
 - 1. Obtain approved borrow soil materials off-site when sufficient satisfactory soil materials are not available on-site.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. Survey the condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.
- E. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.

3.2 UTILITY SERVICES

- A. Maintain existing utilities indicated to remain in service and protect them against damage during demolition operations.
 - 1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by Owner and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Owner and to governing authorities.
 - a. Provide not less than 72 hours' notice to Owner if shutdown of service is required during changeover.
- B. Owner will arrange for disconnecting and sealing indicated utilities serving structures to be demolished before start of demolition work, when requested by Contractor.
- C. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving structures to be demolished.
 - 1. Owner will arrange to shut off indicated utilities when requested by Contractor.
 - 2. Arrange to shut off indicated utilities with utility companies.
- D. Utility Requirements: Refer to "Electrical" and "Mechanical" Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.3 PREPARATION

- A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with demolition operations.
- B. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during demolition operations.
- C. Conduct demolition operations and remove debris 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 governing regulations.
- D. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around demolition area.
 1. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.
 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.
- E. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of buildings to be demolished and adjacent buildings to remain.
 1. Strengthen or add new supports when required during progress of demolition.

3.4 EXPLOSIVES

- A. Explosives: Use of explosives will not be permitted.
- B. Explosives: Do not bring explosives to the site or use explosives without written consent of Owner and authorities having jurisdiction. Such written consent will not relieve Contractor of total responsibility for injury to people or for damage to property due to blasting operations. Perform required blasting in compliance with governing regulations.

3.5 POLLUTION CONTROLS

- A. Use water mist, temporary enclosures, and other suitable methods to limit the spread of dust and dirt. Comply with governing environmental protection regulations.
 1. Do not create hazardous or objectionable conditions, such as ice, flooding, and pollution, when using water.
- B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level.
- C. Clean adjacent buildings and improvements of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before start of demolition.

3.6 DEMOLITION

- A. Building Demolition: Demolish buildings completely and remove from the site. Use methods required to complete Work within limitations of governing regulations and as follows:
 1. Locate demolition equipment throughout the building and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

2. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
 3. Small buildings may be removed intact when permitted by Architect and approved by authorities having jurisdiction.
 4. Demolish concrete and masonry in small sections.
 5. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 6. Break up and remove concrete slabs on grade, unless otherwise shown to remain.
 7. Remove air-conditioning equipment without releasing refrigerants.
- B. Below-Grade Construction: Demolish foundation walls and other below-grade construction, as follows:
1. Remove below-grade construction, including foundation walls, to at least 12 inches (300 mm) below grade.
 2. Remove below-grade construction, including foundation walls and footings, to the depths indicated.
 3. Completely remove below-grade construction, including foundation walls and footings.
 4. Break up and remove below-grade concrete slabs, unless indicated to remain.
 5. Break up below-grade concrete slabs into sections no larger than 24 inches (600 mm) square and leave in place.
- C. Filling Below-Grade Areas: Completely fill below-grade areas and voids resulting from demolition of buildings and pavements with soil materials according to requirements specified in Division 2 Section "Earthwork."
- D. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.
- 3.7 DISPOSAL OF DEMOLISHED MATERIALS
- A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.
- B. Burning: Do not burn demolished materials.
- C. Burning: Burning of demolished materials will be permitted only at designated areas on Owner's property, providing required permits are obtained. Provide full-time monitoring for burning materials until fires are extinguished.
- D. Disposal: Dispose of demolished materials at designated spoil areas on Owner's property.
- E. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

END OF SECTION

Section 31 20 00 – Earth Moving

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Preparing and grading sub-grades for slabs-on-grade, walks, pavements, and landscaping.
 - 2. Drainage and moisture-control fill course for slabs-on-grade.
 - 3. Base course for walks and pavements.
 - 4. Subsurface drainage backfill for walls and trenches.
 - 5. Excavating and backfilling for underground utilities and appurtenances outside building lines.
 - 6. Infiltration Facilities
- B. Related Sections: The following Sections contain requirements that relate to this Section.
 - 1. "Site Clearing" for site stripping, grubbing, topsoil removal, and tree protection.
 - 2. "Foundation Drainage Systems" for footings, underslab, and wall drainage.
 - 3. "Landscape Work" for finish grading, including placing and preparing topsoil for lawns and planting.
 - 4. "Cast-In-Place Concrete" for concrete encasings, cradles, and appurtenances for utility systems.

1.3 REFERENCE SPECIFICATION

- A. Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.

1.4 DEFINITIONS

- A. Excavation: Consists of the removal of material encountered to subgrade elevations and the re-use or disposal of materials removed.
- B. Subgrade: The uppermost surface of an excavation or the top surface of a fill or backfill immediately below aggregate base, drainage fill, or topsoil materials.
- C. Borrow: Soil material obtained off-site when sufficient approved soil material is not available from excavations.

- D. Base Course: The layer placed between the subgrade and surface pavement in a paving system.
- E. Drainage Fill: Course of washed granular material supporting slab-on-grade placed to cut off upward capillary flow of pore water.
- F. Unauthorized Excavation: Consists of removing materials beyond indicated subgrade elevations or dimensions without direction by the Architect. Unauthorized excavation, as well as remedial work directed by the Architect, shall be at the Contractor's expense.
- G. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below ground surface.
- H. Utilities: Include on-site underground pipes, conduits, ducts, and cables, as well as underground services within building lines.
- I. Compaction: Any method of mechanically stabilizing a material by increasing its density at a controlled moisture condition. "Degree of Compaction" is expressed as a percentage of the maximum dry density obtained by the test procedure described in ASTM D 1557 for general soil types abbreviated in this Specification as "___ percent of maximum dry density".
- J. Hard Material: Weathered rock, dense consolidated deposits or conglomerate materials which are not included in the definition of "rock" but which usually require the use of heavy excavation equipment, ripper teeth, or jack hammers for removal.
- K. Lift: A layer or course of soil placed on top of previously prepared or placed soil in a fill or embankment.
- L. Unsatisfactory Material: Soil or other material identified as having insufficient strength or stability to carry intended loads without excessive consolidation or loss of stability.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
 - 1. Location of borrow materials.
- B. Photographs or video tape of existing adjacent structures and site improvements.

1.6 QUALITY ASSURANCE

- A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.
- B. Testing and Inspection Service: District will employ a qualified independent geotechnical engineering testing agency to classify proposed on-site and borrow soils to verify that soils comply with specified requirements and to perform required field and laboratory testing.

- C. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
 - 1. Before commencing earthwork, meet with representatives of the governing authorities, Owner, Architect, consultants, Geotechnical Engineer, independent testing agency, and other concerned entities. Review earthwork procedures and responsibilities including testing and inspection procedures and requirements. Notify participants at least 3 working days prior to convening conference. Record discussions and agreements and furnish a copy to each participant.

1.7 PROJECT CONDITIONS

- A. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted in writing by the Architect and then only after acceptable temporary utility services have been provided.
 - 1. Provide a minimum 48-hours' notice to the Architect and receive written notice to proceed before interrupting any utility.
- B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shutoff services if lines are active.
- C. Groundwater elevations that may be indicated are those existing at the time that subsurface investigations were made and do not necessarily represent groundwater elevations at the time of construction.
- D. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

- A. General: Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.
- B. Satisfactory Soil Materials: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- C. Unsatisfactory Soil Materials: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT.
- D. Backfill and Fill Materials: Satisfactory soil materials.
- E. Base Material: Shall conform to crushed aggregate base or fine-gradation crushed miscellaneous base in accordance with section 200-2.2 or 200-2.4, respectively, of the Reference Specification, and compacted to at least 95% of the maximum dry density as determined by ASTM Test Method D 1557.

- F. Engineered Fill: Well graded granular soil with an expansion index less than 20 and free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation and other deleterious matter.
- G. Bedding Material: Shall be base materials with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve; or clean sand classified in accordance with ASTM D 2487.
- H. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, ASTM D 448, coarse aggregate grading size 57, with 100 percent passing a 1-1/2-inch sieve and not more than 5 percent passing a No. 8 sieve.
- I. Filtering Material: Evenly graded mixture of natural or crushed gravel or crushed stone and natural sand, with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 50 sieve.
- J. Sand: ASTM C33, fine aggregate.
- K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.2 ACCESSORIES

- A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility.
- B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick minimum, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 2'-6" deep.
 - 1. Tape Colors: Provide tape colors to utilities as follows:
 - a. Green: Sewer systems, incl. storm drain.
- C. Filter Fabric: Manufacturer's standard non-woven pervious geotextile fabric of polypropylene, nylon or polyester fibers, or a combination.
 - 1. Provide filter fabrics that meet or exceed the listed minimum physical properties determined according to ASTM D 4759 and the referenced standard test method in parentheses:
 - a. Grab Tensile Strength (ASTM D 4632): 120 lb.
 - b. Apparent Opening Size (ASTM D 4751): #70 U.S. Standard sieve.
 - c. Permeability (ASTM D 4491): 150 gallons per minute per sq. ft.
- D. Subsurface Drainage Geotextile: Manufacturer's standard non-woven needle punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters, with elongation greater than 50 percent, complying with AASHTO M 288 and the following, measured per test methods referenced:
 - 1. Survivability: Class 2, AASHTO M 288.
 - 2. Apparent Opening Size: No. 40 (0.425-mm sieve maximum, ASTM D 4751).
 - 3. Permittivity: 0.5 per second minimum, ASTM D 4491.

4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.
- E. Separation Geotextile: Manufacturer's standard woven geotextile, manufactured for separation applications, made from polyolefins or polyesters, with elongation less than 50 percent, complying with AASHTO M 288 and the following, measured per test methods referenced:
 1. Survivability: Class 2, AASHTO M 288.
 2. Apparent Opening Size: No. 60 (0.250-mm) sieve maximum, ASTM D 4751.
 3. Permittivity: 0.02 per second minimum, ASTM D 4491.
 4. UV Stability: 50 percent after 500 hours' exposure, ASTM D 4355.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.
- B. Provide 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. Tree protection is specified in the "Site Clearing" Section.
- D. Prepare subgrade and place base materials in accordance with sections 301-1.2 and 301-2, respectively, of the Reference Specification.

3.2 DEWATERING

- A. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.
- B. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

3.3 EXCAVATION

- A. General: Shall be to the contours and dimensions indicated. Keep excavations free from water and debris while construction is in progress. Notify the District immediately in writing where it becomes necessary to remove hard, soft, weak, or wet material to a depth greater than indicated. Unless otherwise indicated, concrete placed below grade will be formed and excavations shall allow for placement and removal of forms. Side cuts shall be cribbed and shored as required.
- B. Explosives: Do not use explosives.
- C. Unclassified Excavation: Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

3.4 STABILITY OF EXCAVATIONS

- A. Comply with local codes, ordinances, and requirements of authorities having jurisdiction to maintain stable excavations.
- B. Unshored Temporary Excavations: Unshored temporary excavations may be sloped back at 1 to 1 (horizontal to vertical) or flatter. Where sloped embankments are used, the tops of the slopes should be barricaded to prevent vehicles and storage loads within seven feet of the tops of the slopes. If the temporary construction slopes will be maintained during the rainy season, construct berms along the tops of the slopes where necessary to prevent run-off water from entering the excavation and eroding the slope faces.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.6 EXCAVATION FOR UTILITY TRENCHES

- A. Excavation made with power-driven equipment is not permitted within two feet of any known utility or subsurface construction. For work immediately adjacent to or for excavations exposing a utility or other buried obstruction, use hand or light equipment excavation. Start hand or light equipment excavation on each side of the indicated obstruction and continue until the obstruction is uncovered or until clearance for the new grade is assured. Support uncovered lines and other existing work affected by the excavation work of this Section until approval for backfill is granted by the geotechnical engineer. Immediately report damage to utility lines or subsurface construction to the Owner.
- B. Where unidentified existing utilities are encountered, determine whether these are active or abandoned. Remove interfering portions of abandoned utilities and cap or plug open ends of pipe to remain. The cap or plug must seal the opening in such a manner that would permit remaining portions of the utility to be reactivated. Notify Owner for instructions on utilities which are determined to be active. Do not proceed without instructions, except to correct an immediate hazard or emergency condition. Relocation work performed on an active utility without obtaining prior approval from Owner shall be done at the Contractor's expense and liability.
- C. In areas where compacted backfill has been placed, additional consolidation may occur after completion due to changes in moisture content and surcharge. Utility connections crossing this backfill, and improvements adjoining the building at the backfill line shall be installed taking into account this additional consolidation, or sufficient time shall be scheduled between backfilling operations and such improvements to allow this consolidation to take place. Damage to utilities or other improvements due to Contractor's negligence in regard to this paragraph shall be repaired at the Contractor's expense.

- D. Protect newly backfilled areas and adjacent structures, slopes, or grades from traffic, erosion settlement, and any other damage. Repair and re-establish damaged or eroded grades and slopes and restore surface construction prior to acceptance.
- E. Cutting Pavement, Curbs, and Gutters: Saw cut with neat, parallel, straight lines one foot wider than trench width on each side of trenches and one foot beyond each edge of pits. If an existing pavement joint or cracked area is within two feet outside of a designated sawcut line shown on the Drawings, removal and resurfacing shall be to that joint, and/or shall include the crack or cracked area, unless otherwise approved by Architect.
- F. Contractor shall pothole at all identifiable crossings of existing utilities prior to any trenching operations and provide Architect with a survey of the top elevations (and bottom elevations, if applicable), of possible interferences so that an evaluation of necessary adjustments to the current profile or alignment may be made. Additionally, Architect shall be given the opportunity to view possible conflicts in the field prior to providing revised designs.
- G. Storm drains and sewers shall be to the depths indicated. Where settlements greater than the tolerance allowed herein for grading occur in trenches and pits due to improper compaction, excavate to the depth necessary to rectify the problem, then backfill and compact the excavation as specified herein and restore the surface to the required elevation.
- H. Keep excavations free from water while construction is in progress.
- I. Notify the Owner immediately in writing if it becomes necessary to remove rock or hard, unstable, or otherwise unsatisfactory material to a depth greater than indicated. Excavate large rock, boulders, and other unyielding material to an overdepth at least 6 inches below the bottom of the pipe, conduit, duct and appurtenances, unless otherwise indicated or specified. Over-excavate soft, weak, or wet excavations to an overdepth at least 12 inches below the bottom of the pipe, conduit, duct or appurtenances unless otherwise indicated or specified.
- J. Excavate trenches to indicated slopes, lines, depths, and invert elevations.
 - 1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
- K. Excavate trenches to uniform widths to provide a working 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, except where sloping of sides is allowed. Sides of trenches shall not be sloped from the bottom of the trench up to the elevation of the top of the pipe. See plans for detail.
- L. At the option of the Contractor, the excavations may be cut to an overdepth of not less than 4 inches and refilled to required grade as specified.
- M. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove stones and sharp objects to avoid point loading.

1. For pipes or conduit less than 6 inches in nominal diameter and flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe circumference. Fill depressions with tamped sand backfill.
3. Dig bell holes and depressions for joints after trench has been graded. Dimension of bell holes shall be as required for properly making the particular type of joint to ensure that the bell does not bear on the bottom of the excavation.

3.7 APPROVAL OF SUBGRADE

- A. Notify Architect when excavations have reached required subgrade.
- B. When Architect determines that unforeseen unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
 1. Unforeseen additional excavation and replacement material will be paid according to the Contract provisions for changes in Work.
- C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Architect.

3.8 UNAUTHORIZED EXCAVATION

- A. Fill unauthorized excavation under foundations or wall footings by extending indicated bottom elevation of concrete foundation or footing to excavation bottom, without altering required top elevation. Lean concrete fill with 28-day compressive strength of 2500 psi (17.2 MPa), may be used to bring elevations to proper position when acceptable to the Architect.
 1. Fill unauthorized excavations under other construction as directed by the Architect.
- B. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by the Architect.

3.9 STORAGE OF SOIL MATERIALS

- A. Stockpile excavated materials acceptable for backfill and fill soil materials, including acceptable borrow materials. Stockpile soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent wind-blown dust.
 1. Stockpile soil materials away from edge of excavations a minimum distance of 7 feet or depth of excavation, whichever is greater. Do not store within drip line of remaining trees.

3.10 BACKFILL

- A. Backfill excavations promptly, but not before completing the following:
 1. Acceptance of construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
 2. Surveying locations of underground utilities for record documents.

3. Testing, inspecting, and approval of underground utilities.
4. Concrete formwork removal.
5. Removal of trash and debris from excavation.
6. Removal of temporary shoring and bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL AND COMPACTION

- A. Backfilling of exterior utility trenches shall not be undertaken until geotechnical engineer has received 24-hours notice, until required tests and inspections have been completed, and until as-built location notes have been furnished. Remove uninspected backfill in accordance with requirements of this specification. Use hand-operated, plate-type, vibratory, or other suitable hand tampers in areas not accessible to larger rollers or compactors. Avoid damaging pipes and protective pipe coatings.
- B. Place backfill material in accordance with Section 306-1.3.2 of the Reference Specifications and achieve at least 90% of the maximum density per ASTM D 1557. The top 12 inches of backfill in the building or paved areas shall be compacted to 95% of maximum density per ASTM D 1557.
- C. Compaction by ponding or flooding will not be permitted.
- D. Place and compact bedding course on rock and other unyielding bearing surfaces and to fill unauthorized excavations. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.
- E. Concrete backfill trenches that carry below or pass under footings and that are excavated within 18 inches of footings. Place concrete to level of bottom of footings.
- F. Provide 4-inch-thick concrete base slab support for piping or conduit with less than 2'-6" of cover below finish surface of roadways. After installation and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway base.
- G. Place and compact initial backfill of satisfactory soil material or aggregate base material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
 1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.
- H. Coordinate backfilling with utilities testing.
- I. Fill voids with approved backfill materials as shoring and bracing, and sheeting is removed.
- J. Place and compact final backfill of satisfactory soil material to final subgrade.

- K. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.
- L. Appurtenances: Provide at least 12 inches clear from outer surfaces to the embankment or shoring. Remove rock as specified herein. Remove unstable soil that is incapable of supporting the structure to an over-depth of one foot and refill with gravel or sand to the proper elevation and compact to 95% percent of maximum density.

3.12 FILL

- A. Preparation: Remove vegetation, topsoil, debris, wet, and unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placing fills.
 - 1. Plow strip, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing surface.
- B. When subgrade or existing ground surface to receive fill has a density less than that required for fill, break up ground surface to depth required, pulverize, moisture-condition or aerate soil and re-compact to required density.
- C. Place fill material in layers to required elevations for each location listed below.
 - 1. Under grass, use satisfactory excavated or borrow soil material.
 - 2. Under walks and pavements, use base material or satisfactory excavated or borrow soil material.
 - 3. Under steps and ramps, use base material.
 - 4. Under footings and foundations, use engineered fill.

3.13 MOISTURE CONTROL

- A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to minimum 2 percent above optimum moisture content for cohesive soils and to near optimum for cohesionless soils.
 - 1. Do not place backfill or fill material on surfaces that are muddy, frozen or contain frost or ice.
 - 2. Remove and replace, or scarify and air-dry satisfactory soil material that is too wet to compact to specified density.
 - a. Stockpile or spread and dry removed wet satisfactory soil material.

3.14 COMPACTION

- A. Place backfill and fill materials in layers not more than 8 inches 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 materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure. Keep rollers and other heavy equipment at least 18 inches from footings, foundations, piers and walls of buildings and accessory construction. Use mechanical and hand tampers weighing at least 90 pounds with a maximum face area of 48 inches square to compact backfill within 18 inches of construction and where access is restricted.

- C. Percentage of Maximum Dry Density Requirements: Compact soil to not less than the following percentages of maximum dry density according to ASTM D 1557:
1. For general site fills, compact each layer of backfill or fill material at 90 percent maximum dry density.
 2. Under structures, building slabs, steps, and pavements, scarify and compact the top 12 inches below subgrade at 95 percent maximum dry density.
 3. Under walkways, scarify and compact the top 6 inches below subgrade at 90 percent maximum dry density.
 4. Under lawn or unpaved areas, compact the top 6 inches below subgrade at 85 percent maximum dry density.

3.15 GRADING

- A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
1. Provide a smooth transition between existing adjacent grades and new grades.
 2. Cut out soft spots, fill low spots, and trim high spots to conform to required surface tolerances.
 3. All hillside grading or construction of fill slopes shall conform to the minimum standards listed in Chapter 70 of the UBC.
 4. Fill slopes shall be keyed and benched into firm, natural ground when the existing slope to receive the fill is 5:1 or steeper (horizontal to vertical). Keys shall be tilted into the slope, shall be a minimum of one equipment width wide and shall be a minimum of three feet deep at the outside edge.
 5. If necessary, the Contractor's selected equipment and construction procedure shall be altered, changed or modified in order to meet the specified compaction requirements. Flooding and water jetting is prohibited.
- B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
1. Lawn or Unpaved Areas: Plus or minus 0.10 foot, unless otherwise indicated.
 2. Concrete Walks: Plus or minus 0.05 foot.
 3. Pavements:
 - a. Concrete: 0.02 foot minus, with no high spots.

3.16 BASE COURSE

- A. Under pavements and walks, place base course material on prepared subgrades to pavements.
1. Compact base courses at optimum moisture content to required grades, lines, cross sections and thickness to not less than 95 percent relative compaction in accordance with ASTM D 1557 and ASTM D 4718.
 2. Shape base to required crown elevations and cross-slope grades.
 3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
 4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.17 DECOMPOSED GRANITE

- A. Install decomposed granite (DG) areas to depths indicated on plan.
- B. DG areas shall be treated with "Stabilizer" soil additive at a rate of one pound per ten square feet.
- C. Mix stabilizer thoroughly throughout total depth of DG with 'rototiller' or similar equipment. Grade and smooth surface of DG to desired finish and to the elevations shown. Apply water until moisture penetrates total depth of tilled area. Compact with small riding roller or vibrating plate tamp.

3.18 PAVEMENT REPAIR

- A. Repair or patch concrete pavement, curbs and gutters as specified in Concrete Paving Section. Do not repair pavement until trench has been backfilled and compacted as herein specified. Remove and dispose of temporary road surface material when permanent pavement is placed.

3.19 FIELD QUALITY CONTROL

- A. Testing Agency Services: Allow testing agency to inspect and test each subgrade and each fill or backfill layer. Do not proceed until test results for previously completed work verify compliance with requirements.
 - 1. Perform field in-place density tests according to ASTM D 1556 (sand cone method), ASTM D 2167 (rubber balloon method), or ASTM D 2937 (drive cylinder method), as applicable.
 - a. Field in-place density tests may also be performed by the nuclear method according to ASTM D 6938, provided that calibration curves are periodically checked and adjusted to correlate to tests performed using ASTM D 1556. With each density calibration check, check the calibration curves furnished with the moisture gages according to ASTM D 6938.
 - b. When field in-place density tests are performed using nuclear methods, make calibration checks of both density and moisture gages at beginning of work, on each different type of material encountered, and at intervals as directed by the Architect.
 - 2. Footing Subgrade: At footing subgrades, perform at least one test of each soil stratum to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of each subgrade with related tested strata when acceptable to the Architect.
 - 3. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, perform at least one field in-place density test for every 2,000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
 - 4. Foundation Wall Backfill: In each compacted backfill layer, perform at least one field in-place density test for each 100 feet or less of wall length, but no fewer than two tests along a wall face.
 - 5. Trench Backfill: In each compacted initial and final backfill layer, perform at least one field in-place density test for each 150 feet or less of trench, but no fewer than two tests.

- B. When testing agency reports that subgrades, fills, or backfills are below specified density, scarify and moisten or aerate, or remove and replace soil to the depth required. Re-compact and retest until required density is obtained.

3.20 PROTECTION

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

3.21 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off the property.

END OF SECTION

SECTION 312219 – LANDSCAPE GRADING

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Finished Grading in Landscape Planting Areas, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Finish Grading of Landscape Planting Areas.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 321500 – Aggregate Surfacing.
 - 2. Section 328400 – Irrigation Systems.
 - 3. Section 329113 – Soil Preparation.
 - 4. Section 329200 – Lawns and Grasses.
 - 5. Section 329300 – Exterior Plants.
 - 6. Section 329400 – Landscape Planting Accessories.
 - 7. Section 329813 – Landscape Establishment Period.
 - 8. Section 334300 – Landscape Drainage.

2. SITE CONDITIONS

- A. Dust Nuisance: Contractor shall assume full responsibility for alleviation or prevention of dust as a result of Work under this Section.
- B. Excessive rock, dead or declining vegetation, trash, debris, or other items that has accumulated shall be removed from the Project Site by the Contractor, and as directed by the Landscape Architect, prior to completion of Finish Grading operations.
- C. Work under this Section shall be performed only during the period when beneficial and optimum Landscape Grading results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction. Landscape Grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.
- D. Soil moisture level prior to Landscape Grading shall be no less than 75% of field capacity. The determination of adequate soil moisture for Landscape Grading shall be in the sole judgment of the Landscape Architect.

3. QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications:
 - 1. Valid California C-27 (Landscaping Contractor) License.

- B. Engage an experienced, licensed Contractor who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
- C. Installer's Field Supervision: Contractor shall maintain an experienced, full-time landscape supervisor/superintendent at the Project Site during times that landscaping operations identified herein the Contract are in progress.

4. COORDINATION, SCHEDULING:, AND OBSERVATIONS

- A. Sequencing: Complete Finish Grading after general Soil Preparation (refer to Section 329113) and prior to installation of Irrigation System (Refer to Section 328400) in each area graded.
- B. Re-grade, as required, to acceptable Landscape Grades established by Landscape Architect once irrigation system is installed.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to adequate Finish Grading operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- E. Perform Finish Grading operations only when weather and soil conditions are suitable in accordance with locally accepted practices.
- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective work under this Section at any time during progress of Work. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

2.PRODUCTS (NOT APPLICABLE)

3.EXECUTION

1. EXAMINATION

- A. Verification of Conditions: Verify that the following soil preparation items (per Section 329113) have been completed prior to commencement of Landscape Grading:
 - 1. Installation of (stockpiled) topsoil and soil preparation, including debris removal.
 - 2. Incorporation of soil amendments.

2. INSTALLATION

- A. Subsoil Preparation:

1. Rough grade sub-soil systematically to allow for a maximum amount of natural settlement and compaction. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, etc. Remove sub-soil that has been contaminated with petroleum products.
 2. Cut out areas to subgrade elevation which are to receive stabilizing base for paving and sidewalks.
 3. Bring sub soil to required levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.
 4. Cultivate subgrade to a depth of three-inches (3") where topsoil is to be placed. Repeat cultivation in areas where equipment used for hauling and spreading topsoil has compacted sub-soil.
- B. Finish Grading:
1. In all planting areas, a layer of soil amendments and fertilizers shall be uniformly spread and thoroughly cultivated by means of mechanical tiller as recommended by the approved Agronomic Soil Fertility Report (per Section 329113 – Soil Preparation). Planting areas shall be free of all weeds, construction debris, trash, debris, and rocks 1" in diameter or larger for a minimum depth of two-inches (2").
 2. Provide Finish Grades for natural runoff of water without low spots or pockets. Accurately set flow line grades at a two-percent (2%) minimum positive gradient, unless otherwise noted in the Contract Drawings.
 3. Finish Grades shall be smooth, even, and on a uniform plane with no abrupt changes, pits, or undulations of the surface. Slope grades uniformly between given spot elevations.
 4. Finish Grades not otherwise indicated shall be uniform levels or slopes between points where elevations are given, or between points established by walks, paving, curbs or catch basins.
 5. Tops and toes of slopes shall be gently rounded or feathered to produce a gradual and natural-appearing transition between relatively level areas and slopes, per the satisfaction of the Landscape Architect.
 6. Slope grade away from buildings a minimum two-inches (2") in ten-feet (10') unless otherwise indicated on Contract Drawings.
- C. Tolerances:
1. Planting areas, including areas planted with turf grasses, shall be true to grade within one-inch (1") when tested with a ten-foot (10') straightedge.
 2. Hold Finish Grades in landscape planting areas below top of adjacent pavement, headers, curbs, or walls (where applicable), as follows:
 - a. Shrub, Annual and Groundcover Areas: One and one-half inches (1-1/2").
 - b. Sodded Turf Grass Areas: One-inch (1").

END OF SECTION

DIVISION 32

EXTERIOR IMPROVEMENTS

SECTION 025639 – TEMPORARY TREE & PLANT PROTECTION

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Temporary Tree & Plant Protection, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Protecting and maintaining existing trees and vegetation not specifically designated for removal, to remain.
 - 2. Protection shall be extended to trees and/or vegetation located within or directly adjacent to the Project Site, whether the tree trunk and/or vegetation are located within the designated Limits of Work.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 328400 – Irrigation Systems.
 - 2. Section 329200 – Lawns and Grasses.
 - 3. Section 329300 – Exterior Plants.
 - 4. Section 329400 – Landscape Planting Accessories.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ANSI – American National Standards Institute.
 - 2. ASTM – American Society for Testing & Materials.
 - 3. ISA – International Society of Arboriculture.
 - 4. USDA – United States Department of Agriculture.
- B. Definitions:
 - 1. Tree – A woody perennial plant which usually has (but not limited to) a single dominant trunk and has a mature height of fifteen-feet (15') or more and has a trunk diameter (caliper) of three-inches (3") or more when measured at twenty-four-inches (24") above the finished grade.
 - 2. Drip-line – The outermost extent of the tree's foliated canopy, which encompasses the tree leaves or fronds, trunk, branches, roots, and soil. In no case shall a drip line encompass an area under a tree canopy, which is less than ten-feet (10') in diameter. Since each tree is unique in size, scale, and form, the delineated drip-line of each tree shall be refined at the discretion of the Landscape Architect.
 - 3. Injury – Bruising, scarring, tearing, gouging, or breaking of roots, branches, or trunk(s), soil compaction around the drip-line, or contamination around the drip-line which results in the decline to the health of the tree.
 - 4. Root Zone– The soil volume surrounding a plant containing the roots.
- C. Reference Standards:

1. *American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300)*, American National Standards Institute, Latest Edition.
2. *American National Standard for Tree Care Operations (ANSI Z133)*, American National Standards Institute, Latest Edition.
3. *Tree Pruning Guidelines*, International Society of Arboriculture, 1995 Edition.
4. *Pruning Standards for Shade Trees*, National Arborists Association, Latest Edition.

3. SUBMITTALS

- A. Contractor shall provide site photographs or videotape, sufficiently detailed and described, of existing conditions of trees and vegetation, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing, tree pruning, or tree protection. Submit photographs or videotape to the Landscape Architect prior to commencement of Work.
- B. Product Data: Submit complete and legible materials list of items to be provided for Work described herein this Section.
- C. Submit complete detailed schedule and description of Work to be done within drip-line, (if any), including list of equipment to be used.
- D. Submit schedule and description of proposed pruning and/or other remedial work to existing plant materials. Submit qualifications describing years of experience and list of similar projects completed for the following:
 1. A State of California licensed Pest Control Advisor shall propose application of all herbicides or pesticides.
 2. A Certified Arborist shall propose pruning of trees or other vegetation. The Certified Arborist shall have a minimum of five (5) year's post-certification experience performing pruning and observation work for projects of comparable size with trees of similar size and nature.
 3. Tree Pruning Company, and List of Certified Tree Workers, who will perform Work relating to requirements herein this Section. Tree Pruning Company shall have a minimum of five (5) years experience specializing in performing the work of this Section for projects of comparable size with trees of similar size and nature.

4. QUALITY ASSURANCE AND CONTROL

- A. Pre-Installation Conference: Conduct conference at Project Site.
- B. Pruning and remedial work shall be done under the direct supervision of an Arborist certified by the International Society of Arborists (ISA); or Arborist who is a member in good standing in the American Society of Consulting Arborists, in compliance with ISA and ANSI Standards. Arborist shall be on Site continuously while existing trees or roots are being pruned or remedial work is being performed.

5. PROJECT SITE CONDITIONS

- A. Contractor shall become aquatinted with existing site conditions, verifying quantities and locations of all protected trees and vegetation, and other information as may be necessary. Notify the Landscape Architect of unsatisfactory conditions, in writing, prior to commencement of Work.

- B. Tree Flagging: Prior to commencement of Work, Contractor shall flag existing trees and vegetation to remain and protected throughout the duration of Work. Adequately flag tree trunks with bright-colored tape (neon colors preferred). Verify flagged trees and vegetation with the Landscape Architect.
- C. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during tree-pruning or tree-protection operations.
 - 1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from the Owner and authorities having jurisdiction.
 - 2. Provide alternate routes around closed or obstructed traffic ways, if required, by authorities having jurisdiction.
- D. Locate above utilities prior to any Work, and perform Work in a manner which will avoid possible damage. Notify utility locator service for area where Project is located before site clearing where applicable. Notify the Landscape Architect if conflicts exist.
- E. Improvements on Adjoining Property: Authority for performing indicated removal and alteration Work on property adjoining Owner's property shall be obtained by the adjoining property Owner(s) prior to commencement of Work.
- F. Protect existing Work and Work of other trades: Damage to existing construction caused by Work of this Section shall be promptly repaired and/or replaced at the expense of the Contractor.
- G. Environmental Requirements: Perform actual pruning operations (if needed) during those seasons suitable for the specific tree type, in accordance with locally acceptable horticultural practices.
- H. Pre-Tree Pruning/Tree Protection Conference: Contractor shall conduct a Pre-Tree Pruning/Tree Protection Conference at the Project Site with Certified Arborist (who will be on-site supervising the Work of the Project) and the Landscape Architect.
 - 1. Contractor shall be responsible for notifying parties, in writing, at least seven (7) days in advance to schedule the Conference.
 - 2. Contractor shall provide to parties in attendance within seven (7) days a written legible inventory of Work to be accomplished, including species (botanical and common name), location, size, specific pruning needs or tree protection needs as identified during the Conference, recommended pruning or tree protection methods to meet the identified needs, and any additional conditions noted.

6. SCHEDULE

- A. Install Tree Protection Barricades prior to commencement of Work.
- B. Work shall be done according to approved Schedule.

7. GUARANTEE

- A. Contractor shall Guarantee that plants covered under the Provisions of this Section shall be healthy and in a flourishing condition of active growth for two (2) years from the date of Final Acceptance.

- B. Requirements of the guarantee shall apply if failure of the Contractor to take specified precautions and Work within restrictions of this Section contributes to the destruction, decline, or injury to a tree to remain, in the judgment of the Landscape Architect.
- C. If a tree designated to be protected accordingly is destroyed or injured so that in the judgment of the Landscape Architect it should be replaced, it shall be removed at the expense of the Contractor. Contract shall pay compensation to the Owner of the property where the tree was located at the rate as specified herein this Section (see Compensation).

8. COMPENSATION

- A. Contractor shall replace existing plant material designated to remain that dies or sustained injury from the result of the Contractor's negligence to provide adequate required protection, pruning, or maintenance during the course of construction operations.
- B. Trees: Contractor shall thoroughly remove damaged tree, including trunk, branches, and roots, at no cost to the Owner, and at the direction of the Landscape Architect.
 - 1. Contractor shall furnish and install per requirements in Section 329300 – Exterior Plants, with an equal size tree (in height, spread, and caliper), and of the same form, species, and in the same quantity as those tree(s) that were damaged, at the direction of the Landscape Architect. Compensation shall include the actual cost of the item boxed out of the ground; transportation or delivery of boxed item to the site; unloading, planting and staking; maintenance, including watering, fertilizing, pruning, pest control, and other care to bring replacement to same general condition of the original item.
- C. Other Plant Material (other than Trees): Contractor shall replace other vegetation (other than trees) that died or sustained injury from the result of the Contractor's negligence to provide adequate required vegetation protection, pruning, or maintenance during the course of construction operations. Compensation shall be awarded to the Owner as follows:
 - 1. Contractor shall thoroughly remove damaged vegetation at no cost to the Owner, and at the direction of the Landscape Architect.
 - 2. Contractor shall furnish and install per requirements in Section 329300 – Exterior Plants, with equal size plant material as those which damaged ((5) gallon container stock minimum (as applicable)) of the same form, species, and in the same quantity as vegetation that was damaged, at the direction of the Landscape Architect.

2.PRODUCTS

1. TREE PROTECTION MATERIALS

- A. Barricade for Protection of Existing Vegetation:
 - 1. Fabric: Utility (snow) type fencing, minimum four-feet (4'-0") high, consisting of a vinyl meshed fabric in a bright orange color. Fabric shall be approved by the Landscape Architect.
 - 2. Posts: Metal or wood, sufficient in gauge (as appropriate) and size to support the fabric material in a taut and plumb condition. Posts shall be subject to approval by the Landscape Architect.
 - 3. Signs: Posted plastic laminated signs, attached to fabric fencing, with words "WARNING-KEEP OUT-TREE PROTECTION ZONE".

- B. Mulch: Where available, Contractor shall stockpile and reuse shredded wood chips produced from on-site tree removals and remedial work, if chips are disease free and acceptable to the Landscape Architect. Where on-site chips are not available, Contractor shall provide Shredded Wood Mulch as specified in Section 329400 – Landscape Planting Accessories.

3.EXECUTION

1. PREPARATION

- A. Provide erosion-control measures as needed to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
- B. Locate and clearly flag trees and vegetation to remain or to be relocated.
- C. Protect existing site improvements to remain from damage during construction.

2. TREE AND VEGETATION PROTECTION

- A. Protect existing trees and other vegetation indicated to remain in place against the following:
 - 1. Storage or parking of automobiles or other vehicles.
 - 2. Stockpiling of building materials, refuse, or excavated materials.
 - 3. Use of trees as support posts, power posts, or sign posts, anchorage for ropes, guy wires, or power lines, or other similar functions.
 - 4. Dumping of poisonous materials on or around plant roots, trunks, branches, or foliage. Such materials include, but are not limited to, paint, petroleum products, dirty water, or other deleterious materials.
 - 5. Cutting, breaking, or skinning of roots caused by utility trenching, foundation digging, placement of curbs and trenches, and other miscellaneous excavation without prior written approval by the Landscape Architect.
 - 6. Damage by skinning or bruising of bark on trunks or branches, caused by maneuvering vehicles or stacking material or equipment too close to the plant.
 - 7. Compaction of the soil within the drip-line of the plants due to movement of trucks or grading machines, pedestrian or vehicular traffic, storage of equipment or materials.
 - 8. Excessive water or heat from equipment, utility line construction, or burning of trash under or near vegetation to remain.
 - 9. Damage to root system from flooding, erosion, and excessive wetting and drying resulting from watering and other operations.
- B. Prior to commencement of construction activities, the Contractor shall erect and maintain a temporary fenced barricade around the drip-line of individual trees, around perimeter drip-line of groups of trees, or around other vegetation to remain.
 - 1. Prevent damage to roots during installation of barricade posts. Space posts approximately 4'-0" on-center (O.C.) and securely attach fabric.
 - 2. Barricades shall be installed plumb, taut, and sturdy to prevent unauthorized access around drip-line of trees and protected vegetation. Repair sagging or damaged barricades immediately.
 - 3. Immediately after barricade fencing is installed, cover entire soil area inside of the fence area with a four-inch (4") layer of mulch. Keep mulch eighteen-inches (18") away from root crown. Irrigate protected trees and vegetation to a moist soil depth of eighteen-inches (18") deep.

4. During the course of construction, relocation of the barricade may be required to facilitate construction. Contractor shall relocate barricade as directed by the Landscape Architect at no additional expense to the Owner.
 5. Remove barricade when construction operations are complete or when directed by the Landscape Architect.
- C. Irrigation: Contractor shall supply fresh potable water in adequate amounts and rates of application as required to maintain the health of protected plant material throughout the duration of the construction operations. Contractor shall maintain a watering schedule and document dates and duration of irrigation applications.
1. Construct a temporary watering basin, as required, on the surface of the existing undisturbed grade, with imported soil, to aid in the retention of water around existing protected trees and planting.
- D. Do not excavate within drip line of trees, unless approved, in writing, by the Landscape Architect.
- E. Where excavation for new construction is required within drip line of trees, hand clear and excavate to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
1. Cover exposed roots with burlap and water regularly.
 2. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.
 3. Coat cut faces of roots more than 1-1/2 inches in diameter with emulsified asphalt or other approved coating formulated for use on damaged plant tissues.
 4. Cover exposed roots with wet burlap to prevent roots from drying out. Backfill with soil as soon as possible.
- F. Protect root systems of existing trees and vegetation from damage due to chemically injurious materials in solution caused by run-off or spillage during mixing or placement of construction materials, and drainage of stored materials.
- G. Protect root systems from flooding, erosion, excessive wetting or drying resulting from de-watering or other operations.
- H. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by the Landscape Architect.
1. Employ a qualified arborist, licensed in jurisdiction where Project is located, to submit details of proposed repairs and to repair damage to trees and shrubs.
 2. Replace trees that cannot be repaired and restored to full-growth status, as determined by the qualified Arborist.
3. CLEARING AND GRUBBING
- A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
 2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
 3. Completely remove stumps, roots, obstructions, and debris extending to a depth of eighteen-inches (18") inches below exposed sub-grade.
 4. Use only hand methods for grubbing within drip line of remaining trees.

- B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.

4. PRUNING AND REMEDIAL WORK

- A. Pruning and remedial work shall be done under continuous supervision of the approved Arborist, according to approved submittals, and per ANSI A300 Pruning Standards.
- B. Provide pruning, cabling and bracing, irrigation, pest and disease control and other remedial treatments as recommended by the approved Arborist, required to assure the long-term health of the trees and existing vegetation, and the safety of persons and property.

5. LANDSCAPE ESTABLISHMENT PERIOD

- A. Keep areas within tree protection barricades free from weeds, trash, and debris. Do not use herbicides.
- B. Maintain mulch layer and protective devices throughout entire duration of Contract.

END OF SECTION

SECTION 32 12 16
ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Hot-mix asphalt paving.
 - 2. Hot-mix asphalt patching.
 - 3. Asphalt surface treatments:
 - a. Fog seals.
 - b. Slurries.
 - 5. Subgrade preparation.
- B. Related Sections include the following:
 - 1. "Earth Moving" Section for aggregate base courses and aggregate pavement shoulders.
 - 2. "Concrete Paving Joint Sealants" Section for joint sealants and fillers at paving terminations.
 - 3. "Pavement Marking" Section for pavement marking requirements.

1.3 SYSTEM DESCRIPTION

- A. Provide hot-mix asphalt pavement and/or pervious asphalt paving according to the materials, workmanship, and other applicable requirements of the following standard specifications:
 - 1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
 - 2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.
 - 3. The latest edition of the Asphalt Institute's publication "The Asphalt Handbook".
 - 4. Standard Specifications, July 1999 or latest edition; California Department of Transportation (Caltrans).
 - 5. California Test Methods, latest edition; California Department of Transportation (Caltrans) Transportation Laboratory.

6. Standards of the American Association of State Highway and Transportation Officials (AASHTO), 1998 or latest edition. Standards of the American Association of State Highway and Transportation Officials (AASHTO), 1998 or latest edition.

1.4 SUBMITTALS

- A. Product Data: For each product specified. Include technical data and tested physical and performance properties.
- B. Job-Mix Designs: For each job mix proposed for the Work.
- C. Material Certificates: Certificates signed by manufacturers certifying that each material complies with requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer who has completed hot-mix asphalt paving similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.
- B. Manufacturer Qualifications: Engage a firm experienced in manufacturing hot-mix asphalt similar to that indicated for this Project and with a record of successful in-service performance.
- C. Regulatory Requirements: Conform to applicable standards of authorities having jurisdiction for asphalt paving work on public property.
- E. Asphalt-Paving Publication: Comply with Asphalt Institute's "The Asphalt Handbook," except where more stringent requirements are indicated.
- F. Pre-installation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Management and Coordination" Review methods and procedures related to asphalt paving including, but not limited to, the following:
 1. Review condition of substrate and preparatory work performed by other trades.
 2. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.
 3. Review and finalize construction schedule for paving and related work. Verify availability of materials, paving Installer's personnel, and equipment required to execute the Work without delays.
 4. Review inspection and testing requirements, governing regulations, and proposed installation procedures.
 5. Review forecasted weather conditions and procedures for coping with unfavorable conditions.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not apply asphalt materials if substrate is wet or excessively damp or if the following conditions are not met:
 1. Prime and Tack Coats: Minimum surface temperature of 60 deg F (15.6 deg C).
 2. Slurry Coat: Comply with weather limitations of ASTM D 3910.

3. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.
5. Pervious Bituminous Paving Mixtures: Minimum surface temperature of 55 deg. F (12.5 deg. C) at time of placement.

PART 2 - PRODUCTS

2.1 ASPHALT PAVEMENT MATERIALS

- A. Asphalt Pavement Leveling Course: Conform to Performance Grade B-PG 64-10 in section 203-1.2 and section 203-6 of the Reference Specification.
- B. Asphalt Pavement Wearing (Surface) Course: Conform to Performance Grade III C2-PG 64-10 in section 203-1.2 and section 203-6.
- C. Full Depth Asphalt: When asphalt is to be laid in one lift, conform to Asphalt Concrete Leveling Course.
- D. Prime Coat: Grade SC-70 liquid asphalt conforming to section 203-2 of the Reference Specification.
- E. Tack Coat: Emulsified asphalt grade SS-1h conforming to section 203-3 of the Reference Specification.
- F. Asphalt Paint: conform to ASTM D41 or D43 per Section 203-8 of the Reference Specification.
- G. Slurry Seal: Emulsified asphalt grade SS-1hand aggregate conforming to section 203.5 of the Reference Specification.
- H. Fog Seal: ASTM D 977, emulsified asphalt or ASTM D 2397, cationic emulsified asphalt, slow setting, factory diluted in water, of suitable grade and consistency for application.
- I. Water: Potable.
- J. Pervious Bituminous Asphalt:
 1. Bituminous surface course for pervious paving shall be three (3.0) inches thick with a bituminous mix of 5.5% to 6% by weight dry aggregate. In accordance with ASTM D6390, draindown of the binder shall be no greater than 0.3%. If more absorptive aggregates, such as limestone, are used in the mix then the amount of bitumen is to be based on the

testing procedures outlined in the National Asphalt Pavement Association's Information Series 115 – "Design, Construction, and Maintenance of Open-Graded Asphalt Friction Courses" (2002) or Caltrans equivalent (California Test 368).

2. Use neat asphalt binder modified with an elastomeric polymer to produce a binder meeting the requirements of PG 76-10. The elastomeric polymer shall be styrene-butadiene-styrene (SBS), or approved equal, applied at a rate of 3% by total weight of the binder. The composite materials shall be thoroughly blended at the asphalt refinery or terminal prior to being loaded into the transport vehicle. The polymer modified asphalt binder shall be heat and storage stable.

The Contractor shall submit a certification letter from the polymer-modified asphalt supplier to the Engineer before the mix is placed on the project. The certification letter from the supplier will include the following:

- a. Type of elastomer polymer used to modify the asphalt.
 - b. Quality control sampling and testing procedures used to certify the polymer modified asphalt prior to shipping to the Contractor's asphalt plant.
 - c. Information on the storage and stability of the polymer modified asphalt.
 - d. Recommended mixing and compaction temperatures.
 - e. A statement saying that the polymer modified asphalt will comply with these specifications.
3. Aggregate grading in the asphalt mix shall be:

U.S. Standard Sieve Size	Percent Passing
½" (12.5mm)	100
3/8" (9.5mm)	92-98
4 (4.75mm)	32-38
8 (2.36mm)	12-18
16 (1.18mm)	7-13
30 (600 µm)	0-5
200 (75 µm)	0-3

4. Add hydrated lime at a dosage rate of 1.0% by weight of the total dry aggregate to mixes containing granite. Hydrated lime shall meet the requirements of ASTM C 977. The additive must be able to prevent the separation of the asphalt binder from the aggregate and achieve a required tensile strength ratio (TSR) of at least 80% on the asphalt mix when tested in accordance with California Test 371. The asphaltic mix shall be tested for its resistance to stripping by water in accordance with ASTM D-3625 or California Test 302. If the estimated coating area is not above 95 percent, anti-stripping agents shall be added to the asphalt.

2.2 AUXILIARY MATERIALS

- A. Herbicide Treatment: Commercial chemical for weed control, registered by Environmental Protection Agency (EPA). Provide granular, liquid, or wettable powder form.
- B. Sand: ASTM D 1073, Grade Nos. 2 or 3.

3.1 EXAMINATION

- A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.
- B. Subgrade and Base:
 - 1. Proof-roll [subgrade] [base course] using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.
- C. Notify Architect in writing of any unsatisfactory conditions. Do not begin paving installation until these conditions have been satisfactorily corrected.

3.2 COLD MILLING

- A. Cold mill existing asphalt concrete pavement in accordance with section 302-5.2 of the Reference Specification.

3.3 PATCHING AND REPAIRS

- A. Patching: Saw cut perimeter of patch and excavate existing pavement section to sound base. Re-compact new subgrade. Excavate rectangular or trapezoidal patches, extending 12 inches (300 mm) into adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically.
 - 1. Tack coat faces of excavation and allow to cure before paving.
 - 2. Fill excavation with dense-graded, hot-mix asphalt base mix and, while still hot, compact flush with adjacent surface.
 - 3. Partially fill excavation with dense-graded, hot-mix asphalt base mix and compact while still hot. Cover asphalt base course with compacted, hot-mix surface layer finished flush with adjacent surfaces.
- B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
 - 1. Pump hot undersealing asphalt under rocking slabs until slab is stabilized or, if necessary, crack slab into pieces and roll to re-seat pieces firmly.
 - 2. Remove disintegrated or badly broken pavement. Prepare and patch with hot-mix asphalt.
- C. Leveling Course: Install and compact leveling course consisting of dense-graded, hot-mix asphalt surface course to level sags and fill depressions deeper than 1 inch (25 mm) in existing pavements.

1. Install leveling wedges in compacted lifts not exceeding 3 inches (75 mm) thick.
- D. Crack and Joint Filling: Remove existing filler material from cracks or joints to a depth of 1/4 inch (6 mm). Refill with asphalt joint-filling material to restore watertight condition. Remove excess filler that has accumulated near cracks or joints.
- E. Asphalt paint: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
 1. Allow asphalt paint to cure undisturbed before paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 SURFACE PREPARATION

- A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
 1. Sweep loose granular particles from surface of unbound aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.
- B. Herbicide Treatment: Apply herbicide according to manufacturer's recommended rates and written application instructions. Apply to dry, prepared subgrade or surface of compacted-aggregate base before applying paving materials.
 1. Mix herbicide with prime coat when formulated by manufacturer for that purpose.
- C. Prime Coat: Comply with section 302-5.3 of the Reference Specification. Apply primer at a rate of between 0.20 and 0.25 gallons per square yard to top surface of base course prior to asphalt placement.
- D. Tack Coat: If a leveling course has been used for construction traffic, apply tack coat to all leveling course surfaces in accordance with section 302-5.4 of the Reference Specification at a rate of 0.10 gallons per square yard.
- E. Asphalt Paint: Apply uniformly to existing surfaces of previously constructed asphalt or Portland cement concrete paving and to surfaces abutting or projecting into new, hot-mix asphalt pavement. Apply at a uniform rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m) of surface.
 1. Allow asphalt paint to cure undisturbed before paving.
 2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

- A. Apply bond coat, consisting of asphalt cement, uniformly to existing surfaces at a rate of 0.20 to 0.30 gal./sq. yd. (0.8 to 1.2 L/sq. m).
- B. Place paving geotextile promptly according to manufacturer's written instructions. Broom or roll geotextile smooth and free of wrinkles and folds. Overlap longitudinal joints 4 inches (100 mm) and transverse joints 6 inches (150 mm).
 - 1. Protect paving geotextile from traffic and other damage and place overlay paving the same day.

3.6 HOT-MIX ASPHALT PLACING

- A. The asphalt pavement shall be completed in phases; the leveling course during construction for temporary construction traffic and storage of materials and; the wearing (surface) course just prior to turnover to Owner; unless the entire paving operation is completed just prior to turnover to the Owner. If this method is chosen, then no construction traffic or storage of materials shall be allowed on the finished pavement surface after its completion. Contractor shall schedule final surface course paving operations so that the required waiting period specified in the "Pavement Marking" Section will allow project completion within the specified time.
- B. Construct asphalt pavement in accordance with section 302-5 of the Reference Specification and as shown on the Drawings.
- C. Two Layer Method: The leveling course shall be installed to elevations which will allow the future placement of a wearing (surface) course no thinner than 1-1/2 inches. Prior to placing the wearing (surface) course, repair all areas damaged during construction use, thoroughly clean the leveling course of all loose material and place a tack coat pursuant to paragraph 3.4.D. herein.
- D. Contractor is further cautioned that the use of this two-layer method will result in construction traffic using pavements which are thinner than designed for the traffic expected for the completed project, and that damage due to wheel loads and materials storage during construction is probable. Any such damage shall be repaired to the satisfaction of the Architect and the Owner prior to placement of the surface course.

3.7 JOINTS

- A. Construct joints to ensure continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.
 - 1. Clean contact surfaces and apply tack coat.

2. Offset longitudinal joints in successive courses a minimum of 6 inches (150 mm).
3. Offset transverse joints in successive courses a minimum of 24 inches (600 mm).
4. Construct transverse joints by bulkhead method or sawed vertical face method as described in AI's "The Asphalt Handbook."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

- A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.
 1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).
- B. Breakdown Rolling: Accomplish breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Repair surfaces by loosening displaced material, filling with hot-mix asphalt, and re-rolling to required elevations.
- C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling, while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
 1. Average Density: 96 percent of reference laboratory density according to ASTM D 1559, but not less than 94 percent nor greater than 100 percent.
- D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
- E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while still hot, with back of rake or smooth iron. Compact thoroughly using tamper or other satisfactory method.
- F. Repairs: Remove paved areas that are defective, pond water or are contaminated with foreign materials. Remove paving course over area affected and replace with fresh, hot-mix asphalt, with a thickness one inch greater than the existing, and to match existing finish surface grades such that no local ponding of water will result. Compact by rolling to specified density and surface smoothness. Note that no application of seal coats of any kind will be allowed for any reason on pavements newer than one year. This is to allow for proper curing of the newly placed asphalt pavement, as recommended by The Asphalt Institute.
- G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.
- H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES ASPHALT PAVING

- A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:
 - 1. Leveling Course: Plus or minus 1/2 inch (13 mm).
 - 2. Surface Course: Plus 1/4 inch (6 mm), no minus.

- B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:
 - 1. Leveling Course: 1/4 inch (6 mm).
 - 2. Surface Course: 1/8 inch (3 mm).
 - 3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

3.10 SURFACE TREATMENTS

- A. Fog Seals: Apply fog seal at a rate of 0.10 to 0.15 gal./sq. yd. (0.45 to 0.70 L/sq. m) to existing asphalt pavement and allow to cure. Lightly dust areas receiving excess fog seal with a fine sand.

- B. Slurry seals: Apply in accordance with section 302-4 of the Reference Specification.
 - 1. Roll slurry seal to smooth ridges and provide a uniform, smooth surface.

3.12 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing agency to perform field inspections and tests and to prepare test reports.
 - 1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

- B. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

- C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

- D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

- E. Finish Grade: Completed pavement surface shall be tested for proper drainage through flood testing. Contractor shall schedule a flood test to be held in the presence of the Architect and the Owner to assure that the finished pavement surfaces are consistent with the intent of the Grading Plans with respect to surface drainage, and that drainage devices function properly. It is suggested that a water truck or fire hose be used for the flooding; garden hoses will not be acceptable. Pavements not deemed acceptable subsequent to this

test shall be removed and replaced pursuant to paragraph 3.3 herein. Overlays with thicknesses less than 1-1/2 inches will not be acceptable for these repairs.

- F. In-Place Density: Samples of uncompacted paving mixtures and compacted pavement will be secured by testing agency according to ASTM D 979.
 - 1. Reference laboratory density will be determined by averaging results from 4 samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 1559, and compacted according to job-mix specifications.
 - 2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.
 - a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, but in no case will fewer than 3 cores be taken.
 - b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.
- G. Replace and compact hot-mix asphalt where core tests were taken.
- H. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION

SECTION 321313 – CONCRETE PAVING

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Cast-in-Place Site Concrete Paving, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Cast-in-Place Concrete Ramps.
 - 2. Cast-in-Place Concrete Curbs and Gutters.
 - 3. Cast-in-Place Concrete Walkways, Patios, Courtyards, and/or Plazas.
 - 4. Cast-in-Place Concrete Sidewalks.
 - 5. Jointing (Expansion Joints, Contraction Joints, Isolation Joints, Keyway/Construction Joints and/or Architectural Score Joints).
 - 6. Joint Sealants.
 - 7. Steel Reinforcement (Bars and/or Welded Wire Fabric).
 - 8. Steel Dowels and Sleeves.
 - 9. Compacted Sub-Surface Materials.
 - 10. Concrete Pavement Finishes.
 - 11. Vapor Barrier.
 - 12. Concrete Paving Surface Sealants.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 321323 – Site Concrete (misc. footings, headers, foundations, etc.)
- D. See Division 1 Section “LEED Requirements Summary” for recommendations and requirements for recycled content, regional materials, FSC certified formwork, low-emitting concrete finishes and LEED submittal requirements for all concrete materials.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. AASHTO – American Association of State Highway and Transportation Officials.
 - 2. ADAAG – American with Disabilities Act Accessibility Guidelines.
 - 3. ACI – American Concrete Institute.
 - 4. ANSI – American National Standards Institute.
 - 5. ASTM – American Society for Testing and Materials.
 - 6. CRSI – Concrete Reinforcing Steel Institute.
 - 7. NRMCA – National Ready Mix Concrete Association.
 - 8. PCA – Portland Cement Association.
 - 9. SWRI – Sealant, Waterproofing & Restoration Institute.
 - 10. IBC – International Building Code.
 - 11. CBC – California Building Code, Title 24 Disabled Access Regulations.

B. Definitions:

1. Cementitious Materials: Portland Cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
2. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by Geotechnical Engineer.

C. Standards of Construction:

1. ACI 214 – Recommended Practice for Evaluation of Strength Tests Results of Concrete.
2. ACI 301 – Details and Detailing of Concrete Reinforcement.
3. ACI 303.1 – Standard Specification for Cast-in-Place Architectural Concrete.
4. ACI 304 – Recommended Practices for Measuring, Mixing, Transporting, and Placing of Concrete.
5. ACI 305 – Recommended Practices for Cold Weather Concreting.
6. ACI 306 – Recommended Practices for Hot Weather Concreting.
7. ACI 308 – Standard Practice for Curing Concrete.
8. ACI 347 – Recommended Practice for Concrete Formwork.
9. ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
10. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
11. ASTM C33 – Standard Specification for Concrete Aggregates.
12. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
13. ASTM C94 – Standard Specification for Ready-Mix Concrete.
14. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregate.
15. ASTM C143 – Test Method for Slump of Portland Concrete Cement.
16. ASTM C150 – Standard Specification for Portland Cement.
17. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
18. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
19. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
20. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
21. ASTM C979 – Standard Specification for Pigments for Integrally Colored Concrete.
22. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
23. National Ready Mix Concrete Association, latest revision: *“Certificate of Conformance for Concrete Production Facilities”*.

D. Measurements:

1. PSI: Measurement, in pounds per square inch.
2. CU/FT: Measurement, in cubic-foot.

3. SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.

3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Product/Material Data: Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material:
 - a. Reinforcement and Forming Accessories.
 - b. Cementitious Materials.
 - c. Integral Aggregates (Coarse and Fine).
 - d. Chemical Admixtures.
 - e. Jointing Materials and Systems, including Joint Sealants.
 - f. Curing Compounds.
 - g. Finishing Materials (top-seeding materials, color hardeners, surface retarders, etc.)
 - h. Integral Colors.
 - i. Paving Surface Sealants.
2. Statement of Mix Design: Prepared by the batch plant servicing the Project, submit for each type or load delivered to Project. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each Statement of Mix Design shall include the following:
 - a. Name, address, and telephone number of batch plant preparing Statement of Mix Design.
 - b. Date of Mix Design.
 - c. Project location.
 - d. Contractor requesting load delivery.
 - e. Mix Design Number.
 - f. Admixtures (as required).
 - g. Integral Color Admixtures (as required).
 - h. Gradations for sand and aggregate.
 - i. Material weights, specific gravity, and absolute volumes.
 - j. Basis of testing, i.e. IBC 2605 D4 and CBC Title 24 2604 D4.
 - k. Water/Cementitious Materials Ratio (W/CM Ratio).
 - l. Slump.
 - m. PSI Rating.
3. Material Test Reports: Signed and stamped laboratory test reports for evaluation of concrete materials and mix design tests.
4. Material Certificates: Submit, in lieu of material laboratory test reports, when permitted by the Landscape Architect. Material certificates shall be signed by the Manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.
5. Scaled Shop Drawings: Submit Scaled Shop Drawings for form work, indicating fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, pour sequencing, dimensioned locations of all construction, control and expansion joints, and other items that affect exposed concrete visually.
 - a. Review with the Landscape Architect for general architectural applications and features only. Designing form work for structural stability and efficiency shall be the Contractor's responsibility.
6. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Concrete Paving installations. Include lists of completed projects with project

- names and addresses, names and addresses of Architects/Landscape Architects, Artists and Owners, and other information specified.
7. Minutes of Pre-Installation Conference, distributed and approved in writing as to the content of the conference by concerned parties in attendance.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
1. One (1) 12"-square section of Vapor Barrier.
 2. One-foot (1'-0") section of each Joint Sealant material.
- D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
4. QUALITY ASSURANCE AND CONTROL
- A. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) concrete paving installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
1. Requirement: Valid California C-8 (Concrete Contractor) License.
- B. Applicable Standards of Work:
1. Applicable specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code, with their individual designations, are to be considered part of this Specification. Refer to "Standards of Construction" under "Definitions & Applicable Standards" Article herein this Section.
 2. *Design and Control of Concrete Mixture*, Thirteenth Edition, Portland Cement Association.
 3. *Manual of Standard Practice*, Concrete Reinforcing Steel Institute (CRSI).
 4. *Sealants: The Professional's Guide*, Sealant, Waterproofing & Restoration Institute (SWRI).
- C. Field-Constructed Mock-up Samples:
1. General: Prior to the installation of Work under this Section, Contractor shall erect Field-Constructed Mock-up Samples for each type and pattern of Concrete Paving required for review and approval by the Landscape Architect, to verify selections made under the referee samples obtained by the Landscape Architect.
 2. Build Field-Constructed Mock-up Samples to comply with the following requirements, using materials and same base construction including special features for form work, jointing, surface finishes, textures, color(s), and contiguous Work as indicated for the final unit of Work.

- a. Locate Field-Constructed Mock-up Samples on the Project Site in location(s) as directed by the Owner.
 - b. Notify the Landscape Architect, in writing, at least one (1) week in advance of the dates and times when Field-Constructed Mock-up Samples will be erected.
 - c. Demonstrate quality and range of aesthetic effects and workmanship in the Field-Constructed Mock-up Samples that will be produced in final unit of Work.
 - d. Obtain the Landscape Architect's acceptance of Field-Constructed Mock-up Samples, in writing, before start of installation of Work.
 - e. Retain and maintain Field-Constructed Mock-up Samples during construction in an undisturbed condition as a standard for judging the completed unit of Work.
 - f. When directed by the Owner, Contractor shall demolish and remove Field-Constructed Mock-up Samples from Project Site.
 3. Size: Each Field-Constructed Mock-up Sample within this Section shall measure a minimum of three-feet (3'-0") wide x six-feet (3'-0") long to compare the aesthetics of material colors, textures, and finishes.
 4. When the Landscape Architect determines that a Field-Constructed Mock-up Sample does not meet acceptable requirements, retain it for reference and cast another Field-Constructed Mock-up Sample (as required) until the Sample is accepted.
 5. Accepted Field-Constructed Mock-up Samples will be the standard by which Work under this Section will be evaluated for technical and aesthetic merit. Accepted Field-Constructed Mock-up Samples are the prerequisite to the commencement of Work.
 - D. Single-Source Responsibility: Obtain each color, type, and variety of cementitious materials, aggregates (coarse and fine), chemical admixtures, water source, jointing materials, and other materials, from a single source, with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
 - E. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
 1. Manufacturer shall be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
 - F. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.
 - G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.
 - H. Lines and Levels: To be established by a licensed Surveyor or registered Civil Engineer.
 - I. Permits, Fees, Bonds, Tests, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, tests, and inspections necessary to perform and complete Work under this Section.
 - J. Pre-installation Conference: Before installing Work as indicated herein this Section, conduct a Pre-installation Conference at the Project Site with the Landscape Architect to review requirements and design objectives, including a review of concrete textures, colors, finishes, layouts, and other design intents of the Work. Conference shall be held prior to erecting the Field-Constructed Mock-up Samples.
 1. Notify participants in writing at least five (5) working days prior to Conference.
5. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in a timely manner to ensure un-interrupted progress of the Work.
- B. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.
- C. Store materials by methods that prevent damage and permit ready access for inspection and identification. Package cement delivered to the Project Site shall be in strong paper or jute bags with brand name and manufacturer's name stamped thereon. Store cement under cover. Remove packaged cement immediately from the Project Site should it become wet or show any signs of caking or deterioration.

6. PROJECT SITE CONDITIONS

- A. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities. Access to the surrounding buildings shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
- B. Do not place concrete during rain or adverse weather conditions without means to prevent damage. Conform to requirements specified hereinafter whenever concrete placement is required during cold or hot weather.
- C. Dust Nuisance and Control: Contractor shall assume full responsibility for alleviation or prevention of dust as a result of Work under this Section. Maintain control of Concrete Paving dust during duration of Contract. Do not permit adjacent planting areas to be contaminated. Clean up debris resulting from this work at the end of each day's Work.
- D. Grades and Levels: Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work in this Section with other Work affected.
 - 1. Lines and Levels to be established by a licensed Surveyor or registered Civil Engineer.
- E. Keep Work area clean, and in a safe and workmanlike condition so that rubbish, waste, and debris does not interfere with Work of other trades.

7. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Sequence and Scheduling: Notify Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place, such as:
 - 1. Irrigation Pipe Sleeves under paving. Refer to Section 328400 – Irrigation Systems.
 - 2. Accessories embedded in the concrete, and for the provision of holes, openings, etc., necessary to the execution of the Work of the trades.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.

- D. Excavation: When conditions detrimental to adequate installation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- E. Environmental Conditions: Perform installation operations only when weather and soil conditions are suitable in accordance with locally-accepted practices.
- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

8. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. FORMS

- A. Form Materials: Plywood, wood, MDO plywood, metal, metal-framed plywood, or other approved panel-type materials, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
 - 1. Provide Forms that are full-depth, continuous, straight and free of distortions and defects, and level or sloping along exposed surfaces.
 - 2. Provide Forms of sufficient strength and durability to hold concrete properly in place and prevent leakage of water from Forms.
 - 3. Use flexible spring forms, laminated boards, or foam forms to form radius bends, as required.
 - 4. No wood-textured finish from Forms will be permitted on exposed concrete unless specified as such.

2. STEEL REINFORCEMENT

- A. Plain (Smooth) Steel Welded Wire Reinforcement (to 65,000psi): Meet ASTM A185, fabricated from as-drawn steel wire into flat sheets. Rolls are not acceptable.
- B. Deformed-Steel Welded Wire Reinforcement (to 70,000psi): Meet ASTM A497, flat sheet. Rolls are not acceptable.
- C. Steel Reinforcement Bars: Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
- D. Steel Bar Mats: Meet ASTM A184 with ASTM A615, Grade 60 deformed bars; assembled with clips.
- E. Steel Tie Wire: 16-gauge minimum, black annealed, plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.
- F. Construction/Expansion Joint Dowel Bars & Slip Dowel Sleeves: <<<SELECT PLAIN STEEL OR EPOXY-COATED JOINT BARS>>>
 - 1. Steel Joint Dowel Bars: Meet ASTM A615, Grade 40 smooth, billet-steel, shop painted with iron-oxide zinc-chromate primer, free of rust, dirt, grease, and oils. Cut Bars true to length with ends square and free of burrs.
 - a. Length and Size: As indicated on the Contract Drawings.
 - 2. Epoxy-Coated Steel Joint Dowel Bars: Meet ASTM A775, with ASTM A615, Grade 40, plain steel bars, free of rust, dirt, grease, and oils. Cut Bars true to length with ends square and free of burrs.
 - 3. Slip Dowel Sleeve System: A reusable base and plastic sleeve, manufactured from polypropylene plastic. Encase fifty percent (50%) of each dowel in a plastic sleeve to allow parallel lateral movement of each Dowel. Size of Sleeve to match size of Dowel.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Speed Dowel*, Greenstreak.
 - 2) Or equal (no known equal).
- G. Epoxy-Coated Steel Welded Wire Fabric: Meet ASTM A884, Class A, plain steel, fabricated from as-drawn steel wire into flat sheets. Rolls are not acceptable. <<<VERIFY>>>
- H. Epoxy-Coated Steel Reinforcement Bars: Meet ASTM A775, with ASTM A615, Grade 60, deformed bars. <<<VERIFY>>>
- I. Epoxy-Coated Steel Wire: Meet ASTM A884, Class A coated, plain steel. <<<VERIFY>>>
- J. Epoxy Repair Coating: Liquid, two-part epoxy repair coating, compatible with epoxy coating on reinforcement. <<<VERIFY>>>
- K. Snap Ties: Snap-off metal of fixed length capable of leaving no metal within 1 1/2 in. of surface or causing fractures, spall, or other defects larger than one (1) in. diameter.
- L. Hook Bolts: ASTM A307, Grade A internally and externally threaded. Design hook-bolt joint assembly to hold coupling against pavement form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

- M. Supports for Reinforcement: Lightweight, strong, non-corrosive, durable, and impervious to water. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place, as manufactured from 100% recycled-content plastic or engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Rebar Supports*, Eclipse Plastics Inc.
 - b. *Concrete Casting Plastic Rebar Supports*, Build Global, Inc.
 - c. *Reinforcing Bar Supports*, Shin Hwa Industrial Co.
 - d. *Plastic Rebar Supports*, Plasticon International, Inc.
 - e. *Bar Lift Plastic Support*, New Century Northwest.
 - f. *Aztec Composite Plastic Rebar Supports*, Dayton Superior.
 - g. Or equal, as approved by the Landscape Architect.

3. CONCRETE MATERIALS

- A. Portland Cement: Meet ASTM C150. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Type as follows: <<<SELECT TYPE>>>
1. Cement Type: Type I.
 2. Cement Type: Type II.
 3. Cement Type: Type III.
- B. Normal-Weight Aggregates: Meet ASTM C33, Class 1N, and as follows:
1. Fine Aggregates: Meet ASTM C33, clean, hard, non-reactive, and durable sand, in accordance with SSPWC Section 200-1.5.3
 - a. Grading Requirements:

<u>Sieve Size</u>	<u>Percent Passing</u>
3/8"	100%
No. 4	95-100%
No. 8	75-95%
No. 16	55-75%
No. 30	30-50%
No. 50	10-25%
No. 100	2-10%
 2. Coarse Aggregates: Meet ASTM C33, hard, durable, non-reactive, un-coated, graded, cleaned, and screened crushed rock or gravel aggregate for regular weight concrete.
 - a. Grading: Gradation in accordance with SSPWC-Table 200-1.4(B).
 3. Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Landscape Architect.
- C. Water: Per ASTM C1602, from potable domestic source, free from deleterious materials such as oils, acids, and organic matter.
- D. Pozzolans:

1. Fly Ash: Meet ASTM C618, Type C or F.
2. Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989, Grade 100 or 120.
3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Boral Material Technologies Inc.
 - b. Full Circle Solutions Inc.
 - c. Headwater Resources, Inc.
 - d. Holcim US, Inc.
 - e. Lafarge North America.
 - f. Mineral Resource Technologies, LLC.
 - g. Mineral Solutions, Inc.
 - h. The SEFA Group.

5. CHEMICAL ADMIXTURES FOR CONCRETE

- A. General: Admixtures shall be certified by the Manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other Admixtures. Use of Admixtures shall not relieve the Contractor of the designated concrete requirements, including strength.
- B. Air-Entraining Admixture: Meet ASTM C260.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Daravair 1000*, Grace Construction Products, 800-433-0020.
 - b. *Micro-Air*, Master Builders, Inc., 800-628-9990.
 - c. *Catexol™ A.E. 360*, Axim Italcementi Group, 800-899-8795.
 - d. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- C. Water-Reducing Admixture: Meet ASTM C494, Type A.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *WRDA*, Grace Construction Products, 800-433-0020.
 - b. *Micro-Air*, Master Builders, Inc., 800-628-9990.
 - c. *Eucon NW*, Euclid Chemical Co., 800-321-7628.
 - d. *Catexol™ 3000 GP*, Axim Italcementi Group, 800-899-8795.
 - e. *Plastocrete® 161*, Sika Corporation, 800-933-sika.
 - f. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- D. Water-Reducing and Set Retarding Admixture: Meet ASTM C494, Type B and D.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Daratard 17 Set Retarder*, Grace Construction Products, 800-433-0020.
 - b. *Pozzoloth Retarder*, Master Builders, Inc., 800-628-9990.
 - c. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- E. Shrinkage-Reducing Admixture: Meet ASTM C157. Provide at dosage of 2% by weight of cement.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Eclipse*, Grace Construction Products, 800-433-0020.

- b. *Tetraguard*, Master Builders, Inc., 800-628-9990.
 - c. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
 - F. Dampproofing Admixture: Hydrophobic, Meeting ASTM C836-81, fluid-V single component, bitumen-modified, moisture-curing polyurethane, added at time of batching.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Darapel*, Grace Construction Products, 800-433-0020.
 - b. *Rheomix 235*, Master Builders, Inc., 800-628-9990.
 - c. *Tremproof 60*, Tremco, 800-321-7906.
 - d. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
 - G. Integral Concrete Coloring Admixture: Provide materials specifically designed for use in ready-mix concrete, from a single source, and shall be like in color and visual appearance. Meet ASTM C979.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Refer to the Cast-in-Place Concrete Pavement Schedule indicated herein this Section for requirements.
 - b. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
6. CURING MATERIALS <<<CHOOSE AS REQUIRED>>>
 - A. Absorptive Cover: Burlap cloth, made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.
 - B. Moisture-Retaining Cover: One (1) of the following, complying with ASTM C171. <<<SELECT TYPE>>>
 1. Polyethylene film.
 2. White burlap-polyethylene sheet.
 - C. Clear Solvent-Borne Liquid Membrane-Forming Curing Compound: Spray-applied, ready-to-use, meeting ASTM C309, Type I, Class B. Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *AH Curing Compound #2 DR*, Anti-Hydro International, Inc.
 - b. *Res-X Cure All Resin*, Burke Group, LLC.
 - c. *RX Cure*; Conspec Marketing & Manufacturing Co., Inc.
 - d. *Day-Chem Rez Cure*, Dayton Superior Corporation.
 - e. *Kurez DR*, Euclid Chemical Co.
 - f. *Nitocure S*, Fosroc.
 - g. *#64 Resin Cure*, Lambert Corporation.
 - h. *L&M Cure DR*, L&M Construction Chemicals, Inc.
 - i. *3100-Clear*, W. R. Meadows, Inc.
 - j. *Seal N Kure FDR*, Metalcrete Industries.
 - k. *Rich Cure*, Richmond Screw Anchor Co.
 - l. *Resi-Chem C309*, Symons Corporation.

- m. *Horncure 30*, Tamms Industries Co., Div. of LaPorte Construction Chemicals N.A., Inc.
 - n. *Uni Res 150*, Unitex.
 - o. *Certi-Vex RC*, Vexcon Chemicals, Inc.
 - p. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- D. Clear Water-Borne Membrane-Forming Curing Compound: Spray-applied, ready-to-use, meeting ASTM C309, Type I, Class A. Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *AH Curing Compound #2 DR WB*, Anti-Hydro International, Inc.
 - b. *Spartan-Cote*, Burke Group, LLC.
 - c. *Safe-Cure Clear*, ChemMasters.
 - d. *W.B. Resin Cure*, Conspec Marketing & Manufacturing Co., Inc.
 - e. *Day Chem Rez Cure (J-11-W)*, Dayton Superior Corporation.
 - f. *Cure & Seal 30 EF*, Conspec, Dayton Superior Corporation.
 - g. *Nitocure S*, Fosroc.
 - h. *Aqua Kure-Clear*, Lambert Corporation.
 - i. *L&M Cure R*, L&M Construction Chemicals, Inc.
 - j. *1100 Clear*, W. R. Meadows, Inc.
 - k. *Resin Cure E*, Nox-Crete Products Group, Kinsman Corporation.
 - l. *Rich Cure E*, Richmond Screw Anchor Co.
 - m. *Resi-Chem Clear Cure*, Symons Corporation.
 - n. *Horncure 100*, Tamms Industries Co., Div. of LaPorte Construction Chemicals N.A., Inc.
 - o. *Hydro Cure*, Unitex.
 - p. *Certi-Vex Enviocure*, Vexcon Chemicals, Inc.
 - q. *Clear-Seal 150*, A.C. Horn.
 - r. *Master Seal*, Master Builders.
 - s. *Kure-N-Seal*, Sonneborn.
 - t. *Atlas Quantum –Cure*, Atlas Tech Poducts.
 - u. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- E. White Water-Borne Membrane-Forming Curing Compound: Spray-applied, ready-to-use, meeting ASTM C309, Type 2, Class B. Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *AH Curing Compound #2 WB WP*, Anti-Hydro International, Inc.
 - b. *Aqua Resin Cure*, Burke Group, LLC.
 - c. *W.B. Resin Cure*, Conspec Marketing & Manufacturing Co., Inc.
 - d. *Thinfilm 450*, Kaufman Products, Inc.
 - e. *Aqua Kure-White*, Lambert Corporation.
 - f. *L&M Cure R-2*, L&M Construction Chemicals, Inc.
 - g. *1200-White*, W. R. Meadows, Inc.
 - h. *White Pigmented Resin Cure E*, Nox-Crete Products Group, Kinsman Corporation.
 - i. *Rich Cure White E*, Richmond Screw Anchor Co.

- j. *Resi-Chem High Cure*, Symons Corporation.
 - k. *Horncure 200-W*, Tamms Industries Co., Div. of LaPorte Construction Chemicals N.A. Inc.
 - l. *Hydro White 309*, Unitex.
 - m. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- F. Evaporation Retarder: Waterborne, spray-applied, ready-to-use, mono-molecular film-forming compound, formulated to be applied to fresh concrete surfaces, for temporary protection from rapid moisture loss. Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
- 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Cimfilm*, Axim Concrete Technologies.
 - b. *Finishing Aid Concentrate*, Burke Group, LLC.
 - c. *Spray-Film*, ChemMasters.
 - d. *Aquafilm*, Conspec Marketing & Manufacturing Co., Inc.
 - e. *Sure Film*, Dayton Superior Corporation.
 - f. *Eucobar*, Euclid Chemical Co.
 - g. *Vapor Aid*, Kaufman Products, Inc.
 - h. *Lambco Skin*, Lambert Corporation.
 - i. *E-Con*, L&M Construction Chemicals, Inc.
 - j. *Confilm*, Master Builders, Inc.
 - k. *Waterhold*, Metalcrete Industries.
 - l. *Rich Film*, Richmond Screw Anchor Co.
 - m. *SikaFilm*, Sika Corporation.
 - n. *Finishing Aid*, Symons Corporation.
 - o. *Certi-Vex EnvioAssist*, Vexcon Chemicals, Inc.
 - p. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- G. Surface Set-Retarder: Spray-applied, ready-to-use, water-based solution with color dye, non-staining, non-corrosive, non-flammable, non-toxic, specifically formulated to retard the set of fresh concrete surfaces, temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (to expose the surface aggregates). Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
- 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Top-Cast™*, Grace Construction Products, Inc.
 - b. *TK6000 Concrete Surface Retarder*, TK Products.
 - c. *Top-Etch Surface Retarder*, Unitex Chemicals.
 - d. *R-30 Surface Retarder*, Specco Industries.
 - e. *Certi-Vex Envio Set*, Vexcon Chemicals, Inc.
 - f. *True Etch Surface Retarder*, Burke Group, LLC.
 - g. *Exposee*, ChemMasters.
 - h. *Delay S*, Conspec Marketing & Manufacturing Co., Inc.
 - i. *Concrete Surface Retarders*, Euclid Chemical Co.
 - j. *Expose*, Kaufman Products, Inc.
 - k. *Surftard*, Metalcrete Industries.
 - l. *Crete-Nox TA*, Nox-Crete Products Group, Kinsman Corporation.

- m. *Lithotex*, L. M. Scofield Co.
 - n. *Rugasol-S*, Sika Corporation.
 - o. *Certi-Vex Envioaset*, Vexcon Chemicals, Inc.
 - p. *Atlas Top Etch*, Atlas Tech Products.
 - q. or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
 - H. Spray applied, film forming protective coating, for surfaces adjacent to Set-Retarded finish surfaces.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Face Off*, Grace Construction Products, Inc.
 - b. Or equal, as approved by the Landscape Architect.
 - I. Release Agent for Stamped Concrete Applications: High-performance, colorless, liquid-borne, spray-applied bond breaker material intended for specific use when imprinting freshly placed colored or uncolored concrete flatwork or imprintable cement toppings. Material shall meet the maximum Volatile Organic Compound (VOC) content of 450 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of Nevada.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Lithotex® Liquid Release*, LM Scofield.
 - b. *Brickform Liquid Release™*, Brickform.
 - c. *Liquiform™ Liquid Concrete Release Agent*, Bonway.
 - d. *Liquid Release Agent*, Matcrete.
 - e. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
7. RELATED MATERIALS
- A. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
 - B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - C. Sand for covering Vapor Barrier: Clean, hard, durable, natural Sand, conforming to ASTM C33.
<<<VERIFY>>>
 - D. Rock Salt: Sodium chloride crystals, kiln dried, coarse gradation with one-hundred percent (100%) passing 3/8-inch sieve and eighty-five percent (85%) retained on a No. 8 sieve.
<<<VERIFY IF USING ROCK SALT FINISH>>>
 - E. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rust-proof, non-glazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery with emery aggregate, containing not less than fifty-percent (50%) aluminum oxide, and not less than twenty-five-

percent (25%) ferric oxide; unaffected by freezing, moisture, and cleaning materials.
<<<VERIFY>>>

F. Expansion Joint Materials: <<<SELECT ONE>>>

1. Expansion Joint-Filler Strips:

- a. Asphalt-Saturated Cellulosic Fiber, meeting ASTM D1751, with “guide strip” removable depth gauge cap. Expansion Joint-Filler Strip shall be versatile, resilient, flexible and non-extruding. When compressed to half of its original thickness, it shall recover to a minimum of 70% of its original thickness.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Sealtight Fibre with Snap Cap*, WR Meadows.
 - b) *Fiber Board*, APS Supply.
 - c) or equal, as approved by the Landscape Architect.
 - 2) Thickness/Width: As indicated on the Contract Drawings.
- b. Clean selected Granulated Cork, bonded with a phenolic resin, meeting ASTM D1752, with “guide strip” removable depth gauge cap.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Sealtight Standard Cork*, WR Meadows.
 - b) *Standard Cork Expansion Joint Filler*, APS Supply.
 - c) or equal, as approved by the Landscape Architect.
 - 2) Thickness/Width: As indicated on the Contract Drawings.
- c. Self-sealing, non-absorbent Asphalt, meeting ASTM D944. Installed at ¼” below the finished surface, a joint sealant is not required.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *SealTight Asphalt*, WR Meadows.
 - b) or equal, as approved by the Landscape Architect.
 - 2) Thickness/Width: As indicated on the Contract Drawings.

2. Joint Sealant Backing:

- a. General: Provide Joint Sealant Backings which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved by sealant manufacturer.
- b. Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, non-extruding strips of closed cell plastic foam, of size, shape and density to control sealant depth.
- c. Bond Breaker: Pressure-sensitive tape, as recommended by Joint Sealant manufacturer, to suit application.

3. Miscellaneous Joint Sealant Materials:

- a. Primer: As recommended by joint sealant Manufacturer for adhesion of sealant to joint substrates.
- b. Cleaners for Nonporous Surfaces: Nonstaining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
- c. Masking Tape: Nonstaining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.

4. Joint Sealant:

- a. Horizontal Applications: Meet ASTM C920, Type S (single-component), Grade P (pourable/self-leveling) Class 25 (withstands increase/decrease of 25% of joint width), Use T (pedestrian & vehicular traffic areas), Low-VOC, cold-applied, elastomeric polyurethane Joint Sealant for exterior applications. Color to match adjacent paving color finish.

- 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) Sika Corporation.
 - b) Tremco, Inc.
 - c) Sonneborn.
 - d) Pecora Corporation.
 - e) or equal, as approved by the Landscape Architect.
- G. Vapor Barrier: <<<VERIFY IF REQUIRED>>>
1. Meet ASTM E1745 Class A, as tested through ASTM E154. Polyethylene sheeting, transparent, minimum ten (10) mil. thickness, with impact strength (resistance to puncture) greater than 70 grams/mil., 10'-0" minimum width, and minimum baseline water vapor permeance of .015 perms, as tested per ASTM E96, Procedure B. Provide minimum 2" wide waterproof, polyethylene tape, with rubber-based pressure sensitive self-adhering tape matrix, for sealing edges and ends of sheeting.
 2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *10 mil Stego Wrap*, Stego Industries.
 - b. *Rafco 400*, Raven Industries.
 - c. *Moistop*, Fortifiber Corp.
 - d. *Nervastral Barrier*, Rubber and Plastics Compound, Co.
 - e. *Vinyl Water Barrier*, B.F. Goodrich Corp.
 - f. or equal, as approved by the Landscape Architect.

8. CONCRETE MIXES AND PROPORTIONING

- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength for each type of normal-weight concrete in accordance with current edition of ACI's "Manual of Concrete Practice" and the PCA's "Design and Control of Concrete Mixtures."
 1. Use transit mixer trucks equipped with automatic devices for recording number of revolution of drum.
- B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method, using approved materials to obtain specified minimum compressive strength.
 1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
- C. Slump: Adjust quantity of water so concrete at point and time of discharge does not exceed the aforementioned slumps when tested per ASTM C143. Use the minimum water necessary for workability required by part of item being cast.
- D. Proportion Concrete Mixes to provide Concrete with the following properties:
 1. Vehicular Use Areas:
 - a. Compressive Strength (at 28 Days): Minimum 4,000 PSI. <<<VERIFY>>>
 - b. Maximum Slump Limit: Four-inches (4") at point of discharge, with a 1/2-inch slump differential between successive batches. Obtain approval from the Landscape Architect if slump is outside these parameters. <<<VERIFY>>>
 - c. Maximum Water/Cementitious Materials Ratio: .50.
 - d. Cement Content: Minimum seven (7) - sack mix (658 lbs. cement per cubic yard).
 2. Pedestrian Use Areas:
 - a. Compressive Strength (at 28 Days): Minimum 3,000 PSI. <<<VERIFY>>>

- b. Maximum Slump Limit: Four inches (4") at point of discharge, with a 1/2-inch slump differential between successive batches. Obtain approval from the Landscape Architect if slump is outside these parameters. <<<VERIFY>>>
 - c. Maximum Water/Cementitious Materials Ratio: .50.
 - d. Cement Content: Minimum six (6) - sack mix (564 lbs. cement per cubic yard).
 - E. Cementitious Materials: Limit percentage, by weight, of cementitious materials (other than Portland Cement) in concrete as follows:
 - 1. Fly Ash: Provide twenty-percent (20%) maximum content. <<<VERIFY>>>
 - F. Add Air-Entraining Admixture at the Manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.
 - G. Coloring Agent: Add coloring agent to mix according to Manufacturer's written instructions.
 - H. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
 - I. Concrete Delivery: Use of concrete loads exceeding ninety (90) minutes from time of batch plant must be approved by the Landscape Architect.
 - J. Ensure that the batch plant guarantees a single-source supply for cementitious materials and aggregates (coarse and fine) for the entire project.
9. SURFACE COLOR HARDENER <<<VERIFY>>>
- A. General: Surface Color Hardener shall be a factory-packaged dry combination of cementitious materials containing a combination of Portland cement, graded quartz aggregate, coloring pigments, and plasticizing admixture. Coloring pigments shall meet ASTM C979 for color stability, non-fading mineral oxides inter-ground with cement. Material shall be streak-free, lime-proof, and formulated as a high-opacity color-hardening material for the top surface of freshly placed concrete substrates with maximum resistance to the effects of sunlight and UV.
 - B. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following: <<<SELECT FROM BELOW >>>
 - 1. *Lithochrome® Color Hardener*, L.M. Scofield Company.
 - 2. *Brickform Color Hardener*, Rafco.
 - 3. *Bomanite Color Hardener*, Bomanite Corporation.
 - 4. *QC Color Hardener*, QC Construction Products.
 - 5. *OQ Heavy-Duty Color Hardener*, QC Construction Products.
 - 6. or equal, as approved by the Landscape Architect. Match approved referee sample, as acquired by the Landscape Architect, to compare for material, color, texture, size, and other characteristics relating to aesthetic effects.
 - C. Color(s):
 - 1. Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements.
 - D. Coverage Rate: Provide the recommended coverage rate for each standard and designer color as shown on the selected Manufacturer's Color Hardener Chart. Provide a minimum of 90 pounds/100 SF.
10. CONCRETE MIXING

- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94.
- B. When air temperature is between 85 deg. F. (30 deg. C.) and 90 deg. F. (32 deg. C.), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg. F. (32 deg. C.), reduce mixing and delivery time to 60 minutes.

11. CONCRETE SEALANTS <<<VERIFY TYPE OF SEALER SELECTED>>>

- A. Penetrating Concrete Sealer:
 - 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements.
 - 2. General: Penetrating Concrete Sealer shall be an invisible, water-based penetrating Sealer, used to protect exterior cast-in-place concrete pavement installations. Sealer shall be a clear, non-flammable, UV-stabilized, non-yellowing solution which cures to reduce staining, soiling, discoloration, efflorescence, and acts as a dense, insoluble, invisible water-repellant coating, formulated to impart water repellence and dirt reduction to concrete surfaces with no change in the surface appearance. Sealer shall react with carbon dioxide, and atmospheric moisture to form a penetrating water, dirt and mildew repellent barrier within 24 hours. Moisture absorption rate shall be low to reduce visible surface changes for up to ten (10) years. As recommended for ACI 302 Class 1 through 4 concrete floors.
 - 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Sinak Sealer S-101*, Sinak Corporation.
 - b. *Natural Look Penetrating Sealer*, Glaze 'N Seal.
 - c. *Cementone*, L.M. Scofield Company.
 - d. *Sure Klean Weather Seal SL100*, Prosoco Inc.
 - e. *Sealhard*, L&M Construction Chemicals.
 - f. *White Mountain Ultrapel™*, Triangle Coatings, Inc.
 - g. *Thoroclear® Water-Based Sealer*, Thoro/ChemRex, Inc.
 - h. *HydraSeal*, Endur-O-Seal.
 - i. or equal, as approved by the Landscape Architect.
- B. Multi-Purpose Water-Based (Film-forming) Sealer: (Use for Exposed Aggregate Finishes)
 - 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements.
 - 2. General: Multi-Purpose Water-Based (Film-forming) Sealer shall be a clear, acrylic, non-flammable, non-yellowing, UV-stabilized, water-based Sealer, designed to protect and beautify exterior concrete finishes. Applied by spray or brush in light, even coats, Sealer shall penetrate the surface to give a semi-gloss finish. Sealer shall protect concrete surfaces against organic stains, including oil, grease, and beverages.
 - 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Multi-Purpose Water-Based Sealer*, Glaze 'N Seal.
 - b. *Atlas Outshine Sealer*, Atlas Tech Products.
 - c. *Sinak HLQ-125*, Sinak Corporation.
 - d. *Deep Sheen WB*, Prosoco, Inc.
 - e. *Thoroglaze®*, Thoro/ChemRex, Inc.
 - f. *Cureseal (Semi-Gloss)*, L.M. Scofield Company.
 - g. *Safe Cure & Seal™ 30%*, Dayton Superior Chemical & Cement Products.
 - h. or equal, as approved by the Landscape Architect.
- C. Multi-Purpose Solvent-Based (Film-forming) Sealer: (Use for Exposed Aggregate Finishes)

1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements.
2. General: Multi-Purpose Solvent-Based (Film-forming) Sealer shall be a clear, acrylic, non-yellowing, UV-stabilized, low VOC solvent-based lacquer sealer designed to protect and beautify exterior concrete finishes. Applied by spray or brush in light, even coats, Sealer shall penetrate the surface to give a "wet-look" gloss finish. Sealer shall protect concrete surfaces against organic stains, including oil, grease, and beverages.
3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Wet Look 2000 Lacquer*, Glaze 'N Seal.
 - b. *Atlas Cure & Seal 30%*, Atlas Tech Products.
 - c. *Thoroshield®*, Thoro/ChemRex, Inc.
 - d. *Expo-Gloss*, Sealtight/WR Meadows, Inc.
 - e. or equal, as approved by the Landscape Architect.

3.EXECUTION

1. EXAMINATION

- A. Proof-roll prepared sub-base surface for foundations to check for unstable areas and verify need for additional compaction. Verify that sub-grade preparation for concrete paving has been completed including base course prior to commencement of Work.
- B. Surface Drainage:
 1. Report in writing conflicts discovered on the site or prior Work done by others, which would prevent positive drainage.
 2. Do not permit finished paving surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes.
 3. No "birdbaths" or other surface irregularities shall be permitted. Properly correct irregularities.

2. PREPARATION

- A. Templates: Use templates for anchor plates, bolts, inserts and/or other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.
- B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.
- C. Aggregate Base Course: Compact base course to thicknesses as shown on Contract Drawings or as indicated per the Geotechnical Report, to the relative compaction density as required per the Geotechnical Report. Aggregate Base Course shall be graded to the lines and levels indicated; no ruts or depressions shall be allowed.
- D. Gravel Fill or Sand Beds: Re-compact disturbed gravel fill or sand beds and bring to correct elevation.
- E. Vapor Barrier <<<VERIFY>>>
 1. Install, protect, and repair Vapor Barrier sheets according to ASTM E1643. Place sheets in position with longest dimension parallel with direction of pour.

2. Lap joints six-inches (6") and seal with Manufacturer's recommended tape.
3. Cover Vapor Barrier with a minimum two-inch (2") layer of clean damp sand.

3. FORMWORK

- A. Design, construct, erect, shore, brace, and maintain Formwork according to ACI 347 *"Guide to Formwork for Concrete."*
- B. Formwork shall be consistent with the orientation and pattern indicated on the Contract Drawings. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install Formwork to allow continuous progress of Work and so that Formwork can remain in place at least twenty-four (24)-hours after concrete placement.
- C. Coordinate locations of drainage piping requirements, irrigation piping stub-outs, electrical conduits, or other items scheduled to be embedded into cast concrete.
- D. Check completed Formwork and screeds for grade and alignment to following tolerances:
 1. Top of Forms: Not more than 1/8 inch in ten- (10) feet.
 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in ten-(10) feet.
- E. Coat Formwork with Form Release Agent, as required, to ensure Formwork separates from cast concrete without damage to concrete.
 1. Formwork surfaces shall be clean, dry, and free from contaminants (dirt, dust, rust, build-up, and existing form agents) prior to each use of Formwork
 2. Prior to each use, Formwork that comes into direct contact with concrete shall be coated with Form Release Agent in accordance with the Manufacturer's written instructions.
 3. Apply Form Release Agent in a uniform and even manner by low pressure spray, roller, or clean cloth, in accordance with the Manufacturer's written instructions.
 4. Prior to coating new Formwork, apply one (1) or two (2) heavy coats to edges for waterproofing protection.
 5. Excess Form Release Agent or dense form surfaces should be removed with a clean cloth.
 6. Do not apply Form Release Agent to reinforcing steel.
- F. Screeds:
 1. Set screeds at maximum 8'-0" centers between. Set to provide at grades per Contract Drawings. Check with an instrument level, transit, or laser during placing operations to maintain desired grades.
 2. Screeds over Vapor Barriers: <<<VERIFY>>> Use weighted pad or cradle-type screeds and do not drive stakes through the Vapor Barrier. Check with an instrument level, transit, or laser.

4. STEEL REINFORCEMENT

- A. General: Comply with CRSI's *"Manual of Standard Practice"* for fabricating reinforcement and with recommendations in CRSI's *"Placing Reinforcing Bars"* for placing and supporting reinforcement.
- B. Clean Reinforcement of loose rust and mill scale, earth, or other bond-reducing materials.

- C. Arrange, space, and securely Tie Bars and Bar Supports to firmly hold and support the Steel Reinforcement in position during concrete placement and to prevent displacement before or during casting. Maintain a minimum of two inches (2") cover to the Reinforcement.
- D. Install Steel Reinforcement Bars in sizes as indicated on the Contract Drawings, in lengths as long as practicable. Lap adjoining Bars at a minimum of fifty (50) bar diameters. Lace splices accordingly with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Reinforcement Bars on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Reinforcement Bars through expansion joints.
- E. <<<<VERIFY>>>>Install Welded Wire Reinforcement (where required) in sizes as indicated on the Contract Drawings, in continuous lengths as long as practicable. Lap adjoining pieces at least one-one half (1-1/2) courses of the full Reinforcement mesh, and a minimum of six-inches (6"). Lace splices with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Reinforcement on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Welded Wire Reinforcement through expansion joints.
- F. Install Construction Joint Dowel Bars & Sleeves per the Manufacturer's recommendation. Reinforcing dowels, or sleeves for the reinforcing dowels, shall be secured in place prior to placing concrete. Align dowels in straight, even alignments in the middle of the concrete profile during casting operations. Dowels and sleeves shall not be pressed into the concrete during casting and after the concrete has been placed.
- G. <<<<VERIFY>>>>Install fabricated Steel 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 two-inch (2") overlap to adjacent mats.
- H. <<<<VERIFY>>>>Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated reinforcement, as required.
- I. <<<<VERIFY>>>>Vapor Barrier: If provided, do not cut or puncture Vapor Barrier. Repair damage and reseal Vapor Barrier before placing concrete.

5. CONCRETE PLACEMENT

- A. Preparation: Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.
- B. Sub-Base: Sub-Base shall be free of ruts, holes, ridges, etc. Smooth and compact sub-base to an even plane.
- C. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability. Dampen earth sub-grade twenty-four (24) hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness, and remove loose material from compacted sub-base surface prior to placing concrete.

- D. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, dowels/sleeves, and items to be embedded or cast in. Notify other trades to permit installation of their Work.
 - 1. Reinforcement and Forms shall be secured firmly in position such that they will not be displaced during the placement of concrete.
 - 2. Reinforcement Bars, Ties, and Welded Wire Reinforcement <<<VERIFY>>> shall be completely encased in concrete, at a maximum of two-inches (2") from the edge of the concrete.
 - 3. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- E. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- 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. <<<VERIFY>>> Welded Wire Reinforcement, where specified, shall be secured firmly in position on chairs in the middle of the concrete paving during casting operations. Should Reinforcement become loose from the chairs, pull Reinforcement into position as the concrete is placed by means of hooks. Concrete shall be worked under the reinforcement to insure that it is at the proper distance in the middle of the cast concrete
- H. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 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.
- I. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments
- J. When adjoining pavement lanes are placed in separate pours, do not operate equipment on concrete until pavement has attained eighty-five-percent (85%) of its fully hydrated compressive strength.
- K. Cold-Weather Placement: Comply with ACI 306.1, and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg. F. (4.4 deg. C.), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F. (10 deg. C.) and not more than 80 deg. F. (27 deg. C.) at point of placement.
 - 2. Do not use calcium chloride, salt, or other materials containing anti-freeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- L. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg. F. (32 deg. C.). Chilled mixing water or chopped ice may be used to

- control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 3. Fog-spray forms, reinforcement steel, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

6. JOINTS

- A. General: Refer to ACI 302 *"Guide for Concrete Floor and Slab Construction"* for work under this Article. Construct construction, isolation, expansion, and contraction joints and tool edgings 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 (1/2) hour, unless paving terminates at isolation joints.
 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated on the Contract Drawings.
 2. Provide tie bars at sides of paving strips where indicated.
 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, buildings, foundations, walls, other fixed objects, and in other locations as indicated on the Contract Drawings. Provide Expansion Joints at full depth of concrete paving where paving meets the vertical faces of buildings, structures, foundations, walls, etc.
 1. Locate expansion joints at maximum intervals of twenty (20) feet, unless otherwise indicated on the Contract Drawings.
 2. Extend joint fillers full width and depth of joint.
 3. Provide Construction Joint Dowel Bars at the spacing distances indicated in the Contract Drawings.
 4. Terminate Joint Filler less than 1/2 inch or more than one-inch (1") below finished surface if joint sealant is indicated.
 5. Place top of Joint Filler flush with finished concrete surface if joint sealant is not indicated.
 6. Furnish joint fillers in one (1)-piece lengths. Where more than one (1) length is required, lace or clip joint-filler sections together.
 7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.
- D. Contraction Joints and Isolation Joints: Form weakened-plane contraction joints and isolation joints, sectioning concrete into areas as indicated on the Construction Drawings, or at spacing intervals as recommended by the PCA.
 1. General Methodology: Contraction Joints shall be placed in Concrete Paving to minimize the occurrence of random cracking on the surface due to drying shrinkage or stress loading and to reduce the width of concrete cracks should they occur. When not

indicated on the Contract Drawings, Contraction Joints shall be placed at 24x the thickness of the concrete paving.

2. Saw-Cut Contraction Joints:

- a. Construct Saw-Cut Contraction Joints with a circular power saw, equipped with a new, shatterproof abrasive or diamond-tipped blade. Cut 3/16-inch-wide joints (maximum width of saw-blade) into concrete surface. Cutting action shall not tear, abrade, spall, shatter, or otherwise damage the surface.
- b. Saw-cut concrete surface when successful jointing results can be achieved and prior to uncontrolled random contraction cracking of concrete occurs.
 - 1) Early-entry Sawcuts: When used, provide sawcuts into fresh concrete at 1" to 1-1/4" depth, or as indicated on the Contract Drawings.
- c. Perform saw-cut joints cleanly and smoothly, to a constant and equal depth, in a continuous consistent line, with no over-cutting.
- d. Depth:
 - 1) Contraction Joints: Construct depth equal to a minimum of one-fourth (1/4) of the concrete slab thickness.
 - 2) Isolation Joints: Construct depth equal to the full depth of the concrete thickness.
- e. Perform in as continuous an operation as possible, to avoid misalignment of joints. Use chalk lines, forms, or templates as required, to achieve consistent lines)
- f. Use a hand grinder with a 4-inch diamond blade to saw-cut up to vertical edges such as walls, steps, curbs and columns. Do not over-cut into vertical surfaces or adjacent concrete surfaces.

7. CONCRETE FINISHES

A. General:

1. Finished pavement surfaces indicated herein this Section shall be "slip-resistant", per the requirements outlined in CBC, Section 1124B.1, and ADAAG 4.5.1.
 - a. The minimum coefficient of friction shall meet or exceed 0.8 on exterior and 0.6 on interior surfaces.
 - b. Pavement surfaces shall have the following finish on all surfaces less than six percent (6%) slope:
 - 1) Medium Broom Textured Finish, or a textured finish as specified, which is equivalent to the finished texture of a Medium Broom Textured Finish for slip resistance.
 - c. Pavement surfaces shall have the following finish on all surfaces greater than six percent (6%) slope:
 - 1) Heavy Broom Textured Finish, or a textured finish as specified, which is equivalent to the finished texture of a Heavy Broom Textured Finish for slip resistance.
 - d. Color(s) and finish(es) specified herein shall match referee samples and field-constructed mock-up samples as approved by the Landscape Architect.
 - e. Wetting of concrete surfaces during screeding, initial floating, or finishing operations is strictly prohibited.

B. Exposed-Aggregate/Retarded Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.

1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
2. Preparation and Application: Protect all curbs, borders, adjacent stones, pavers, etc. that are not to receive Exposed-Aggregate/Retarded Textured Finish prior to application of

Set Retarder. Use product as indicated herein this Section per Manufacturer's printed instructions.

3. Once concrete has been floated, bleed-water sheen has disappeared, and the concrete surface has stiffened sufficiently, evenly spray-apply the chemical Surface Retarder to the concrete surface. Apply the Surface Retarder according to the Manufacturer's written instructions for applying the Retarder. Do not use curing compounds.

a. Retarder Selection Guidelines:

Number Code	Etch/Aggregate Size to Expose	Coverage	Color
03	Acid Etch Finish	250/350 S.F. / Gal.	Lt. Blue Violet
05	Lt. Sandblast Finish	250/350 S.F. / Gal.	Lt. Blue
15	Up to 1/4"	250/350 S.F. / Gal.	Yellow
25	1/8" to 1/4"	250/350 S.F. / Gal.	Beige
50	1/8" to 3/8"	250/350 S.F. / Gal.	Canary Green
75	1/8" to 3/8"	250/350 S.F. / Gal.	Blue
100	3/8" to 1/2"	250/350 S.F. / Gal.	Gray
125	3/8" to 5/8"	250/350 S.F. / Gal.	Pink
150	3/8" to 5/8"	250/350 S.F. / Gal.	Green
200	5/8" to 1"	250/350 S.F. / Gal.	Salmon
250	1" to 1-1/2"	250/350 S.F. / Gal.	Orange

4. Handle the chemical Surface Retarder with care to avoid spillage and staining. Protect areas adjacent to the Work from over-spray of the Retarder. Provide neutralizing solution(s) to the Retarder solution, as needed, to prevent chemicals from damaging or contaminating adjoining planting areas.
5. Immediately after applying the Surface Retarder, damp-cure the sprayed concrete surface with moisture-retaining cover, adequately securing around the edges of the pavement to prevent 'ballooning' of the sheeting. The sheeting should be in direct contact with the top surface of the freshly poured concrete.
6. After the Surface Retarder has adequately etched into the surface and the concrete has hardened sufficiently (generally overnight, or when the concrete has hardened adequately to support the weight of a person), remove the moisture-retaining cover in sections, checking a small area to determine if the proper depth has been achieved. If the depth appears too deep, wait a few hours to check again.
7. With a hose, lightly spray the top surface of the concrete with water. Remove the Retarded matrix through a process of gently brushing surface with a stiff, nylon bristle broom and flushing with water to expose the coarse aggregates used in the concrete mix. Repeat the water flushing and brushing cycle, as needed, until the retarded matrix has been removed and the surface texture is acceptable, being careful not to dislodge the surface aggregates. **DO NOT USE A HIGH PRESSURE WASHER TO APPLY WATER OR TO REMOVE THE ACID SOLUTION FROM THE SURFACE.** Retarder removal intervals depend on strength of mix, exposed aggregate size and desired washing techniques. Earlier washing for light etch finishes may be necessary.
8. After concrete is sufficiently hydrated, provide jointing in the locations indicated in the Contract Drawings. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces (Note: Provide Sawcut Joints for best finish)

9. After concrete is fully hydrated (approx. 30 days), seal exposed aggregate/retarded texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for Sealer requirements. (NOTE: For best finish, use the Water-Based or Solvent Based Sealer on this finish)
- H. Top Cast/Retarded Sand Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
 2. Once concrete has been floated, bleed-water sheen has disappeared, and the concrete surface has stiffened sufficiently, evenly spray-apply the Top Cast Chemical Surface Retarder to the concrete surface. Apply the Top Cast Chemical Surface Retarder according to the Manufacturer's written instructions for applying the chemical. Do not use curing compounds.
 3. Handle the chemical Top Cast Chemical Surface Retarder with care to avoid spillage and staining. Protect areas adjacent to the Work from over-spray of the chemical.. Provide neutralizing solution(s) to the chemical solution, as needed, to prevent chemicals from damaging or contaminating adjoining planting areas.
 4. Immediately after applying the Top Cast Chemical Surface Retarder, damp-cure the sprayed concrete surface accordingly to the manufacturer's written instructions.
 5. After the Top Cast Chemical Surface Retarder has adequately etched into the surface and the concrete has hardened sufficiently (generally overnight, or when the concrete has hardened adequately to support the weight of a person), check a small area to determine if the proper retarded depth has been achieved. If the depth appears too shallow wait a few hours to check again.
 6. With a hose, lightly spray the top surface of the concrete surface with water. Remove the Top Cast Chemical Surface Retarder matrix through a process of gently brushing surface with a stiff, nylon bristle broom and flushing with water to remove the surface paste, exposing the fine aggregates integral to the concrete mix. Repeat the water flushing and brushing cycle, as needed, until the retarded matrix has been removed and the surface texture is acceptable. **DO NOT USE A HIGH PRESSURE WASHER TO APPLY WATER OR TO REMOVE THE CHEMICAL SOLUTION FROM THE SURFACE.**
 7. After concrete is sufficiently hydrated, provide jointing in the locations indicated in the Contract Drawings. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces. (Note: Provide Sawcut Joints for best finish)
 8. After concrete is fully hydrated (approx. 30-days), seal the Top Cast Chemical Surface Retarded (Sand) texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Pavement Schedule indicated herein this Section for Sealer requirements.
- I. Sandblast Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
 2. Work shall conform to CAL OSHA /MSDS for application and clean up procedures.
 3. After concrete is fully hydrated (approx. 30-days), provide a sandblast-textured finish to the exposed concrete surfaces, revealing the desired aggregates, with the following surface texture:
 - a. Light Sandblast Texture.

4. Provide jointing in the locations indicated in the Contract Drawings. (Note: Provide Sawcut Joints for best finish)
 5. Seal sandblast texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for Sealer requirements.
 - J. Color Dry-Shake Hardener Textured Finish: Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish, and other characteristics relating to aesthetic effects.
 1. Applications: Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
 2. After initial floating, apply Colored Dry-Shake Hardener materials to pavement surfaces according to selected Manufacturer's written instructions, and as follows:
 - a. Consult selected Manufacturer and revise rate of application, if required.
 - b. Rate: Uniformly apply the Colored Dry-Shake Hardener materials at a rate of 100 lb/100 sq. ft., unless greater amount is recommended by Manufacturer to match pavement color required. (Rate indicated is usually recommended for light traffic)
 3. Uniformly distribute approximately two-thirds (2/3) of Colored Dry-Shake Hardener material over the concrete surface with mechanical spreader, and embed by power floating. Follow power floating with a second shake application, uniformly distributing remainder (1/3) of Colored Dry-Shake Hardener material to ensure uniform color, and embed by power floating. (Note: Coordinate selection of curing compounds for compatibility with dry-shake materials and revise lists in Part 2 accordingly, if necessary)
 3. After final floating, apply a hand-trowel finish followed by a broom-textured finish to the concrete surface. Cure concrete with curing compound recommended by the Colored Dry-Shake Hardener material manufacturer. Apply curing compound immediately after final finishing.
8. CONCRETE PROTECTION AND CURING
- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
 - B. 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.
 - C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
 - D. 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 (7) 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 for curing concrete, placed in widest practicable width, with sides and ends lapped

- at least twelve inches (12") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during 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. Re-coat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

9. INSTALLATION OF JOINT SEALANTS

- A. Provide a Joint Sealant that is compatible with the substrate material(s) to which it is being applied. Do not use a Joint Sealant that has exceeded shelf life or has jelled and can not be discharged in a continuous flow from the application tool.
- B. Ambient Temperature Criteria: The ambient temperature shall be within the limits of 40d. F. and 90d. F. when the Joint Sealant is being applied.
- C. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of Joint Sealants as applicable to materials, applications and conditions indicated.
- D. Surface Preparation of Joints:
 1. Remove foreign material from joint substrates which could interfere with adhesion of Joint Sealant, including dust, surface dirt, dirt, moisture, water repellents, grease, oil, wax, lacquer, paint, waterproofing, or other foreign matter that would tend to destroy or impair adhesion.
 2. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths.
 3. Clean porous surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or acid washing to produce a clean, sound substrate. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints.
 4. Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing.
 5. Clean nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of Joint Sealants.
- E. Sealant Preparation: Do not add liquids, solvents, or powders to the Joint Sealant material (for single-component materials). Where specified, mix multi-component elastomeric Joint Sealants in accordance with manufacturer's instructions.
- F. Primer: Immediately prior to application of the Joint Sealant, clean out loose particles from joints. Where recommended by the sealant manufacturer, apply Primer to joints in accordance with sealant manufacturer's instructions. Do not apply Primer to exposed finish surfaces. Do not allow spillage or migration of Primer onto adjoining surfaces.
- G. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
 1. Install Joint Fillers to provide sealant support for optimum performance crosssectional shapes and depths.
 - a. Do not leave gaps between ends of Joint Fillers.
 - b. Do not stretch, twist, puncture or tear Joint Fillers.
 - c. Remove absorbent Joint Fillers which have become wet prior to sealant application and replace with dry material.
 2. Install Bond Breaker to the back or bottom of the joint cavity (between sealants and jointfillers, compression seals or back of joints where required), as recommended by the Joint Sealant manufacturer, for each type of joint and sealant used, to prevent "third-side"

adhesion of the Joint Sealant to the back of the joint. Carefully apply the Bond Breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the Bond Breaker.

- H. Installation of Joint Sealants:
 - 1. Install Joint Sealant after concrete substrate material has been cast and allowed to cure. Remove protective cap from preformed Joint Filler. Remove any excess Joint Filler material that will inhibit an adequate depth and bond of the Joint Sealant material.
 - 2. Place masking tape where required along the joint cavity to prevent contact of the Joint Sealant with adjoining surfaces. Remove masking tape within ten (10) minutes after joint has been filled and tooled.
 - 3. Apply the Joint Sealant in accordance with the manufacturer's printed instructions with an application tool having a nozzle that fits the width of the joint cavity. Install Joint Sealant by proven techniques to contact and solidly full wet joint substrates, completely filling the recesses provided for each joint configuration, providing uniform, optimum performance crosssectional shapes and depths. Do not allow spillage or migration of Joint Sealant onto adjoining surfaces.
- I. Tooling of Non-Sag Joint Sealants: Tool Non-Sag Joint Sealants to form smooth, uniform beads of configuration indicated, free of wrinkles, streaks, gouges, boils, air holes, etc. and to ensure contact and adhesion of the Joint Sealant with the sides of the joint. Remove excess Joint Sealants from surfaces adjacent to joint. Do not use tooling agents which discolor Joint Sealants or adjacent surfaces or are not approved by Sealant Manufacturer.
- J. Sanding of Joint Sealant: Lightly apply dry sand to cover freshly-poured elastic Joint Sealant material. When Joint Sealant has hardened, remove excess sand that has not bonded to Joint Sealant.
- K. Protection and Curing:
 - 1. Protect installed Joint Sealants during and after curing period from contact with contaminating substances or from damage.
 - 2. Cut out and remove damaged or deteriorated Joint Sealers and reseal joints with matching new materials.
 - 3. Clean off excess Joint Sealants or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by the Sealant Manufacturer.

10. APPLICATION OF CONCRETE SEALANTS

- A. Penetrating Concrete Sealer: <<<VERIFY IF USED>>>
 - 1. After cast-in-place concrete is fully hydrated (approx. 30-days), seal concrete paving surfaces with two (2) coats of approved Penetrating Concrete Sealer. Apply in accordance with Manufacturer's written directions. Finished surfaces shall be uniform in appearance and not mottled.

11. PAVEMENT TOLERANCES

- A. Comply with tolerances of ACI 117, and as follows:
 - 1. Elevation: 1/4 inch.
 - 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 - 3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch. Variation from the Level or from the Grades shown, per Civil Engineer Drawings:
 - a. In pavements:

- 1) In any ten-feet (10'): 1/4 inch.
- 2) In twenty-feet (20'): maximum 3/8 inch.
- 3) In forty-feet (40') or more: 3/4 inch.
- b. Variation in Radii:
 - 1) In radii of less than ten-feet (10'):
 - a) In any five-feet (5'): 1/8 inch.
 - b) In any ten-feet (10'): 1/4 inch.
 - 2) In radii of twenty feet (20'):
 - a) In any ten-feet (10'): 1/4 inch.
 - b) In any twenty-feet (20'): 3/8 inch.
 - 3) In radii of thirty-feet (30'), or more:
 - a) In any twenty-feet (20'): 1/2 inch.
 - b) In any thirty-feet (30'): 1 inch.
4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
6. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch.
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: Length of dowel 1/4 inch per 12 inches.
8. Joint Spacing: Three inches (3").
9. Contraction Joint Depth: Plus 1/4 inch, no minus.
10. Joint Width: Plus 1/8 inch, no minus.

12. FIELD QUALITY CONTROL

A. Testing Agency:

1. Engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Section.
2. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C172, except modified for slump to comply with ASTM C94.
2. Slump: Per ASTM C143; one (1) test at point of placement for each compressive-strength test, but not less than one (1) test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.
3. Air Content: Per ASTM C231, pressure method; one (1) test for each compressive-strength test, but not less than one (1) test for each day's pour of each type of air-entrained concrete.
4. Concrete Temperature: Per ASTM C1064; one (1) test hourly when air temperature is 40 deg F. and below and when 80 deg. F. and above, and one (1) test for each set of compressive-strength specimens.
5. Compression Test Specimens: Per ASTM C31; one (1) set of four (4) standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
6. Compressive-Strength Tests: Per ASTM C39; one (1) set for each day's pour of each concrete class exceeding five (5) cu. yd. but less than 25 cu. yd., plus one (1) set for each additional 50 cu. Yd. One (1) specimen shall be tested at seven (7) days and two (2) specimens at twenty-eight (28) days; one (1) specimen shall be retained in reserve for later testing, if required.

7. When frequency of testing will provide fewer than five (5) compressive-strength tests for a given class of concrete, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
 8. When total quantity of a given class of concrete is less than 50 cu. yd., the Landscape Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
 9. When strength of field-cured cylinders is less than eighty-five-percent (85%) of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
 10. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 PSI.
- C. Test results shall be reported in writing to the Owner, concrete manufacturer, and Contractor within 24-hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28-days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner, but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing Agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by the Owner. Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed.
13. REPAIRS AND PROTECTION
- A. Remove in its entirety (from joint to joint) and replace concrete pavement that is broken, cracked, damaged, or defective, or concrete which does not meet requirements of this Section.
- B. Drill test cores where directed by the Landscape Architect, when necessary, to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory pavement areas with Portland cement concrete bonded to pavement with epoxy adhesive.
- C. Protect concrete from damage. Exclude traffic from pavement for at least fourteen (14) days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.
- D. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two (2) days before date scheduled for Substantial Completion inspections.

14. CAST-IN-PLACE CONCRETE PAVING SCHEDULE

Concrete Pavement Type (as noted in Contract Drawings)	Portland Cement Type	Maximum Aggregate Size	Integral Color Admixture or Surface Dry-Shake Color Hardener or Stained Surface	Min. Compressive Strength at 28 days (in PSI)	Maximum Water/Cementitious Materials (W/CM) Ratio (in %)	Maximum Slump Limit (in inches)	Air Entrainment	Finish (including Sealer Type)
Type-1	Type I	¾"	Davis Colors to match existing concrete	3,000	.50	4"	5%-7%	Finish to TBD by LA with Penetrating Concrete Sealer
Type-2	Type I	¾"	Davis Colors - Grey, to be confirmed by Landscape Architect	3,000	.50	4"	5%-7%	Finish to TBD by LA with Penetrating Concrete Sealer

END OF SECTION

SECTION 321323 – SITE CONCRETE

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work for Reinforced Cast-in-Place Site Concrete, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Cast-in-Place Site Concrete for site walls, seat walls, pilasters, columns, etc.
 - 2. Cast-in-Place Site Concrete for miscellaneous footings or sub-grade foundations.
 - 3. Cast-in-Place Site Concrete for sub-surface slabs (Veneer pavements).
 - 4. Installation of anchor bolts, hangers, anchors, plates, inserts, and miscellaneous metal or other materials embedded in Cast-in-Place Site Concrete and which are furnished by other trades or Sections.
 - 5. Cast-in-Place Concrete for Work specified in Electrical Sections unless specifically included therein.
 - 6. Concrete Formwork.
 - 7. Jointing (Expansion Joints, Contraction Joints, Isolation Joints, Keyway/Construction Joints and/or Architectural Score Joints).
 - 8. Concrete Curing.
 - 9. Concrete Joint Sealants.
 - 10. Reinforcement, Tie Wire, and Bar Supports.
 - 11. Steel Dowels and Sleeves.
 - 12. Compacted Sub-Surface Materials.
 - 13. Site Concrete Finishes.
 - 14. Vapor Barrier.
 - 15. Site Concrete Surface Sealants.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 042200 – Concrete Unit Masonry.
 - 2. Section 044200 – Exterior Dimension Stone.
 - 3. Section 071416 – Cold Fluid Applied Waterproofing.
 - 4. Section 107500 – Flagpoles.
 - 5. Section 129300 – Site and Street Furnishings.
 - 6. Section 321313 – Concrete Paving.
 - 7. Section 334300 – Landscape Drainage.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. AASHTO – American Association of State Highway and Transportation Officials.
 - 2. ACI – American Concrete Institute.
 - 3. ADAAG – American with Disabilities Act Accessibility Guidelines.
 - 4. ANSI – American National Standards Institute.
 - 5. ASTM – American Society for Testing and Materials.

6. CBC – California Building Code, Title 24 Disabled Access Regulations.
7. CRSI – Concrete Reinforcing Steel Institute.
8. NRMCA – National Ready Mix Concrete Association.
9. PCA – Portland Cement Association.
10. SSPWC – Standard Specifications for Public Works Construction.
11. SWRI – Sealant, Waterproofing & Restoration Institute.
12. IBC – International Building Code.

B. Definitions:

1. Cementitious Materials: Portland Cement alone or in combination with one or more of blended hydraulic cement, expansive hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.
2. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by Geotechnical Engineer.

C. Standards of Construction:

1. ACI 117 – Standard Specifications for Tolerances for Concrete Construction and Materials.
2. ACI 214 – Recommended Practice for Evaluation of Strength Tests Results of Concrete.
3. ACI 301 – Details and Detailing of Concrete Reinforcement.
4. ACI 303.1 – Standard Specification for Cast-in-Place Architectural Concrete.
5. ACI 304 – Recommended Practices for Measuring, Mixing, Transporting, and Placing of Concrete.
6. ACI 305 – Recommended Practices for Cold Weather Concreting.
7. ACI 306 – Recommended Practices for Hot Weather Concreting.
8. ACI 308 – Standard Practice for Curing Concrete.
9. ACI 347 – Recommended Practice for Concrete Formwork.
10. ASTM A185 – Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
11. ASTM A615 – Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
12. ASTM C33 – Standard Specification for Concrete Aggregates.
13. ASTM C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens.
14. ASTM C94 – Standard Specification for Ready-Mix Concrete.
15. ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregate.
16. ASTM C143 – Test Method for Slump of Portland Concrete Cement.
17. ASTM C150 – Standard Specification for Portland Cement.
18. ASTM C171 – Standard Specification for Sheet Materials for Curing Concrete.
19. ASTM C260 – Standard Specification for Air-Entraining Admixtures for Concrete.
20. ASTM C309 – Liquid Membrane-Forming Compounds for Curing Concrete.
21. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.
22. ASTM C920 – Standard Specification for Elastomeric Joint Sealants.
23. ASTM C979 – Standard Specification for Pigments for Integrally Colored Concrete.
24. ASTM C1193 – Standard Guide for Use of Joint Sealants.
25. ASTM C1315 – Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
26. ASTM C1602 – Standard Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete.
27. ASTM D1751 – Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-Extruding and Resilient Bituminous Types).
28. National Ready Mix Concrete Association, latest revision: *“Certificate of Conformance for Concrete Production Facilities”*.

- D. Measurements.
 - 1. PSI: Measurement, in pounds per square foot.
 - 2. CU/FT: Measurement, in cubic-foot.

3. SUBMITTALS

- A. General:
 - 1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 - 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 - 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
 - 1. Product/Material Data: Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material:
 - a. Reinforcement and Forming Accessories.
 - b. Steel Dowels and Sleeves.
 - c. Cementitious Materials.
 - d. Integral Aggregates (Coarse and Fine).
 - e. Chemical Admixtures.
 - f. Jointing Materials and Systems, including Joint Sealants.
 - g. Concrete Curing Materials.
 - h. Finishing Materials.
 - i. Site Concrete Surface Sealants.
 - 2. Statement of Mix Design: Prepared by the batch plant servicing the Project, submit for each type or load delivered to Project. Include revised mix proportions when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments. Each Statement of Mix Design shall include following information:
 - a. Name, address, and telephone number of batch plant preparing Statement of Mix Design.
 - b. Date of Mix Design.
 - c. Project location.
 - d. Contractor requesting load delivery.
 - e. Mix Design Number.
 - f. Admixtures (as required).
 - g. Integral Color Admixtures (as required).
 - h. Gradations for sand and aggregate.
 - i. Material weights, specific gravity, and absolute volumes.
 - j. Basis of testing, i.e. UBC 2605 D4 and CBC Title 24 2604 D4.
 - k. Water/Cementitious Materials Ratio (W/CM Ratio).
 - l. Slump.
 - m. PSI Rating.
 - 3. Material Test Reports: Signed and stamped laboratory test reports for evaluation of concrete materials and mix design tests.

4. Material Certificates: Material certificates, in lieu of material laboratory test reports, when permitted by the Landscape Architect. Material certificates shall be signed by the Manufacturer and Contractor certifying that each material item complies with or exceeds requirements. Provide certification from admixture manufacturers that chloride content complies with requirements.
 5. Scaled Shop Drawings: Submit Scaled Shop Drawings for form work, indicating fabrication and erection of forms for specific finished site concrete surfaces. Show form construction including jointing, special form joints or reveals, location and pattern of form tie placement, pour sequencing, dimensioned locations of all construction, control and expansion joints, and other items that affect exposed concrete visually.
 - a. Review with the Landscape Architect for general architectural applications and features only. Designing form work for structural stability and efficiency shall be the Contractor's responsibility.
 6. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Site Concrete installations. Include lists of completed projects with project names and addresses, names and addresses of Architects/Landscape Architects, Artists and Owners, and other information specified.
 7. Minutes of Pre-Installation Conference, distributed and approved in writing as to the content of the conference by concerned parties in attendance.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
1. One (1) 12"-square section of Vapor Barrier.
 2. One-foot (1'-0") section of each Concrete Joint Sealant material.
- D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
4. QUALITY ASSURANCE AND CONTROL
- A. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) concrete installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
1. Requirement: Valid California C-8 (Concrete) Contractor License.
 - 2.
- B. Applicable Standards of Work:
1. Applicable specifications and recommended practices of American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code, with their individual designations, are to be considered part of this Specification. Refer to "Standards of Construction" under "Definitions & Applicable Standards" Article herein this Section.

2. *Design and Control of Concrete Mixture*, Thirteenth Edition, Portland Cement Association.
 3. *Manual of Standard Practice*, Concrete Reinforcing Steel Institute (CRSI).
 4. *Sealants: The Professional's Guide*, Sealant, Waterproofing & Restoration Institute (SWRI).
- C. Field-Constructed Mock-up Samples:
1. General: Prior to the installation of Work under this Section, Contractor shall erect Field-Constructed Mock-up Samples for each type and pattern of Concrete Paving required for review and approval by the Landscape Architect, to verify selections made under the referee samples obtained by the Landscape Architect.
 2. Build Field-Constructed Mock-up Samples to comply with the following requirements, using materials and same base construction including special features for form work, jointing, surface finishes, textures, color(s), and contiguous Work as indicated for the final unit of Work.
 - a. Locate Field-Constructed Mock-up Samples on the Project Site in location(s) as directed by the Owner.
 - b. Notify the Landscape Architect, in writing, at least one (1) week in advance of the dates and times when Field-Constructed Mock-up Samples will be erected.
 - c. Demonstrate quality and range of aesthetic effects and workmanship in the Field-Constructed Mock-up Samples that will be produced in final unit of Work.
 - d. Obtain the Landscape Architect's acceptance of Field-Constructed Mock-up Samples, in writing, before start of installation of Work.
 - e. Retain and maintain Field-Constructed Mock-up Samples during construction in an undisturbed condition as a standard for judging the completed unit of Work.
 - f. When directed by the Owner, Contractor shall demolish and remove Field-Constructed Mock-up Samples from Project Site.
 3. Size: Each Field-Constructed Mock-up Sample within this Section shall measure a minimum of six-feet long x 9' high (6'-0"x9'-0") to compare the aesthetics of material colors, textures, and finishes.
 4. When the Landscape Architect determines that a Field-Constructed Mock-up Sample does not meet acceptable requirements, retain it for reference and cast another Field-Constructed Mock-up Sample (as required) until the Sample is accepted.
 5. Accepted Field-Constructed Mock-up Samples will be the standard by which Work under this Section will be evaluated for technical and aesthetic merit. Accepted Field-Constructed Mock-up Samples are the prerequisite to the commencement of Work.
- D. Single-Source Responsibility: Obtain each color, type, and variety of cementitious materials, aggregates (coarse and fine), chemical admixtures, water source, jointing materials, and other materials, from a single source, with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- E. Concrete Manufacturer Qualifications: Manufacturer of ready-mixed concrete products complying with ASTM C94 requirements for production facilities and equipment.
1. Manufacturer shall be certified according to the National Ready Mix Concrete Association's Plant Certification Program.
- F. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C1077 and ASTM E329 to conduct the testing indicated, as documented according to ASTM E548.
- G. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixes.

- H. Lines and Levels: To be established by a licensed Surveyor or registered Civil Engineer.
- I. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
- J. Pre-installation Conference: Before installing Work as indicated herein this Section, conduct a Pre-installation Conference at the Project Site with the Landscape Architect to review requirements and design objectives, including a review of concrete textures, colors, finishes, layouts, and other design intents of the Work. Conference shall be held prior to erecting the Field-Constructed Mock-up Samples.
 - 1. Notify participants in writing at least five (5) working days prior to Conference.

5. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in a timely manner to ensure un-interrupted progress of the Work.
- B. Store materials in a dry and protected location. Protect reinforcing steel and dowels from rusting, deformation, staining, and moisture damage.
- C. Store materials by methods that prevent damage and permit ready access for inspection and identification. Package cement delivered to the Project Site shall be in strong paper or jute bags with brand name and manufacturer's name stamped thereon. Store cement under cover. Remove packaged cement immediately from the Project Site should it become wet or show any signs of caking or deterioration.

6. PROJECT SITE CONDITIONS

- A. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities. Access to the surrounding buildings shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
- B. Do not place Site Concrete during rain or adverse weather conditions without means to prevent damage. Conform to requirements specified hereinafter whenever concrete placement is required during cold or hot weather.
- C. Dust Nuisance and Control: Contractor shall assume full responsibility for alleviation or prevention of dust as a result of Work under this Section. Maintain control of Site Concrete dust during duration of Contract. Do not permit adjacent planting areas to be contaminated. Clean up debris resulting from this work at the end of each day's Work.
- D. Grades and Levels: Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work in this Section with other Work affected.
 - 1. Lines and Levels to be established by a licensed Surveyor or registered Civil Engineer.
- E. Keep Work area clean, and in a safe and workmanlike condition so that rubbish, waste, and debris does not interfere with Work of other trades.

7. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Sequence and Scheduling: Notify contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion

of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place, such as:

1. Accessories embedded in Site Concrete, and for the provision of holes, openings, etc., necessary to the execution of the Work of the trades.
 2. Irrigation Pipe Sleeves through Walls. Refer to Section 328400 – Irrigation Systems.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to adequate installation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- E. Environmental Conditions: Perform installation operations only when weather and soil conditions are suitable in accordance with locally-accepted practices.
- F. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

8. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. FORMS

- A. Form Materials: Plywood, wood, MDO plywood, metal, metal-framed plywood, or other approved panel-type materials, of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal.
1. Provide Forms that are full-depth, continuous, straight and free of distortions and defects, and level or sloping along exposed surfaces.
 2. Provide Forms of sufficient strength and durability to hold concrete properly in place and prevent leakage of water from Forms.
 3. Use flexible spring forms, laminated boards, or foam forms to form radius bends, as required.
 4. No wood-textured finish from Forms will be permitted on exposed Site Concrete surfaces unless specified as such.
 5. Textured Form Facings: Refer to Contract Drawings or requirements indicated herein this Section, as required.
- B. Form Release Agent: Premium, Volatile Organic Compound (VOC)-compliant (low to no VOC), 100% biodegradable liquid-based (either natural emulsified vegetable oil-based, soy-based, or water-based), colorless, non-staining Form Release Agent. Agent shall not bond with, leave no residual matter on concrete surfaces, nor adversely affect the bond or performance of subsequent treatments to the concrete surfaces.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Atlas Bio-Guard 2000*, Atlas Tech Products.
 - b. *Bio Release Agent*, Burke, Edoco.
 - c. *Enviroform, Conspec*, Dayton Superior Company.
 - d. *Bio-Form*, Leahy-Wolf Company.
 - e. *Crete-Lease 20-VOC*, Cresset Chemical Company.
 - f. *Duogard II*, W.R. Meadows, Inc.
 - g. *FORMSHIELD WB*, Tamms Industries.
 - h. *Greenplus Form Release Agent ES*, Greenland Corporation.
 - i. *Soy Form Release and Natural Form Oil*, Natural Soy, LLC.
 - j. *SOYsolv Concrete Form Release Agent*, SOYsolv.
 - k. Or equal, as approved by the Landscape Architect.

2. STEEL REINFORCEMENT

- A. Welded Wire Reinforcement:
1. Plain (Smooth) Steel Welded Wire Reinforcement (to 65,000psi): Meet ASTM A185, fabricated from as-drawn steel wire into flat sheets. Rolls are not acceptable.
 2. Deformed-Steel Welded Wire Reinforcement (to 70,000psi): Meet ASTM A497, flat sheet. Rolls are not acceptable.
- B. Steel Reinforcement Bars:
1. Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
- C. Steel Bar Mats:
1. Meet ASTM A184 with ASTM A615, Grade 60 deformed bars; assembled with clips.
- D. Steel Tie Wire:
1. 16-gauge minimum, black annealed, plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.

- E. Construction/Expansion Joint Dowel Bars & Slip Dowel Sleeves:
1. Steel Joint Dowel Bars: Meet ASTM A615, Grade 40 smooth, billet-steel, shop painted with iron-oxide zinc-chromate primer, free of rust, dirt, grease, and oils. Cut Bars true to length with ends square and free of burrs.
 - a. Length and Size: As indicated on the Contract Drawings.
 2. Slip Dowel Sleeve System: A reusable base and plastic sleeve, manufactured from polypropylene plastic. Encase fifty percent (50%) of each dowel in a plastic sleeve to allow parallel lateral movement of each Dowel. Size of Sleeve to match size of Dowel.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Speed Dowel*, Greenstreak.
 - 2) Or equal (no known equal).
- F. Epoxy-Coated Reinforcement: <<<VERIFY>>>
1. Epoxy Coated Steel Welded Wire Fabric: Meet ASTM A884, Class A, plain steel, fabricated from as-drawn steel wire into flat sheets. Rolls are not acceptable.
 2. Epoxy-Coated Steel Reinforcement Bars: Meet ASTM A775, with ASTM A615, Grade 60, deformed bars.
 3. Epoxy-Coated Steel Wire: Meet ASTM A884, Class A coated, plain steel.
 4. Epoxy-Coated Steel Joint Dowel Bars: Meet ASTM A775, with ASTM A615, Grade 40, plain steel bars, free of rust, dirt, grease, and oils. Cut Bars true to length with ends square and free of burrs.
 5. Epoxy Repair Coating: Liquid, two-part epoxy repair coating, compatible with epoxy coating on reinforcement.
- G. Snap Ties: Snap-off type of fixed length, capable of leaving no ties within 1 1/2 in. of surface or causing fractures, spall, or other defects larger than one (1) in. diameter. <<<SELECT>>>
1. Steel Snap Ties.
 2. Fiberglass Snap Ties.
- H. Hook Bolts: Meet ASTM A307, Grade A internally and externally threaded. Design hook-bolt joint assembly to hold coupling against site concrete form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.
- I. Supports for Reinforcement: Lightweight, strong, non-corrosive, durable, and impervious to water. Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place, as manufactured from 100% recycled-content plastic or engineered resins from recycled ABS plastic, polycarbonates, and fiberglass.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Rebar Supports*, Eclipse Plastics Inc.
 - b. *Concrete Casting Plastic Rebar Supports*, Build Global, Inc.
 - c. *Reinforcing Bar Supports*, Shin Hwa Industrial Co.
 - d. *Plastic Rebar Supports*, Plasticon International, Inc.
 - e. *Bar Lift Plastic Support*, New Century Northwest.
 - f. *Aztec Composite Plastic Rebar Supports*, Dayton Superior.
 - g. Or equal, as approved by the Landscape Architect.

3. CONCRETE MATERIALS

- A. Portland Cement: Meet ASTM C150. Use one (1) brand of cement (single source) throughout the Project, unless otherwise acceptable to the Landscape Architect. Contractor shall verify the cement color with the Landscape Architect. Cement Type as follows: <<<SELECT TYPE>>>
1. Cement Type: Type I.
 2. Cement Type: Type II.
 3. Cement Type: Type III.
- B. Normal-Weight Aggregates: Meet ASTM C33, Class 1N, and as follows:
1. Fine Aggregates: Meet ASTM C33, clean, hard, non-reactive, and durable sand. Do use sand coated with injurious amounts of silt, loam, clay or other deleterious matter.
 - a. Grading Requirements:

Sieve Size	Percent Passing
3/8"	100%
No. 4	95-100%
No. 8	75-95%
No. 16	55-75%
No. 30	30-50%
No. 50	10-25%
No. 100	2-10%
 2. Coarse Aggregates: Meet ASTM C33, hard, durable, non-reactive, un-coated, graded, cleaned, and screened crushed rock or gravel aggregate for regular weight concrete. Do not use crusher-run stone or bank-run gravel. Aggregate shall be from a single source and shall be like in visual appearance.
 - a. Grading: Gradation in accordance with SSPWC-Table 200-1.4(B). Do not use coarse aggregates that contain substances that cause spalling.
 3. Local aggregates not complying with ASTM C33 that have been shown to produce concrete of adequate strength and durability by special tests or actual service may be used when acceptable to the Landscape Architect.
- C. Water: Per ASTM C1602, from potable domestic source, free from deleterious materials such as oils, acids, and organic matter.
- D. Pozzolans:
1. Fly Ash: Meet ASTM C618, Type C or F.
 2. Ground Granulated Iron Blast-Furnace Slag: Meet ASTM C989, Grade 100 or 120.
 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Boral Material Technologies Inc.
 - b. Full Circle Solutions Inc.
 - c. Headwater Resources, Inc.
 - d. Holcim US, Inc.
 - e. Lafarge North America.
 - f. Mineral Resource Technologies, LLC.
 - g. Mineral Solutions, Inc.
 - h. The SEFA Group.

5. CHEMICAL ADMIXTURES FOR CONCRETE

- A. General: Admixtures shall be certified by the Manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other Admixtures. Use of Admixtures shall not relieve the Contractor of the designated concrete requirements, including strength.
- B. Air-Entraining Admixture: Meet ASTM C260.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Daravair 1000*, Grace Construction Products, 800-433-0020.
 - b. *Micro-Air*, Master Builders, Inc., 800-628-9990.
 - c. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- C. Water-Reducing Admixture: Meet ASTM C494, Type A.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *WRDA*, Grace Construction Products, 800-433-0020.
 - b. *Micro-Air*, Master Builders, Inc., 800-628-9990.
 - c. *Eucon NW*, Euclid Chemical Co., 800-321-7628.
 - d. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- D. Water-Reducing and Set Retarding Admixture: Meet ASTM C494, Type B and D.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Daratarad 17 Set Retarder*, Grace Construction Products, 800-433-0020.
 - b. *Pozzoloth Retarder*, Master Builders, Inc., 800-628-9990.
 - c. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- E. Shrinkage-Reducing Admixture: Meet ASTM C157. Provide at dosage of 2% by weight of cement.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Eclipse*, Grace Construction Products, 800-433-0020.
 - b. *Tetraguard*, Master Builders, Inc., 800-628-9990.
 - c. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- F. Damp-proofing Admixture: Hydrophobic, Meeting ASTM C836-81, fluid-V single component, bitumen-modified, moisture-curing polyurethane, added at time of batching.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Darapel*, Grace Construction Products, 800-433-0020.
 - b. *Rheomix 235*, Master Builders, Inc., 800-628-9990.
 - c. *Tremproof 60*, Tremco, 800-321-7906.
 - d. Or equal, as approved by the Landscape Architect.
 - 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- G. Integral Concrete Coloring Admixture: Provide materials specifically designed for use in ready-mix concrete, from a single source, and shall be like in color and visual appearance. Meet ASTM C979.

1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Refer to the Cast-in-Place Site Concrete Schedule indicated herein this Section for requirements.
 - b. Or equal, as approved by the Landscape Architect.
2. Application Rate: Per selected Manufacturer's latest printed instructions.

6. CURING MATERIALS

- A. Absorptive Cover: Provide one (1) of the following:
 1. Burlap Cloth, made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.
 2. Curing Blanket: Single-use, non-woven synthetic (inorganic) fabric, specifically manufactured to provide a continuous supply of moisture for a gradual and controlled freshly-casted concrete curing environment.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *HydraCure S16*, PNA Construction Technologies, Inc.
 - 2) *UltraCure*, McTech Group.
 - 3) Or equal, as approved by the Landscape Architect.
- B. Moisture-Retaining Cover: Provide one (1) of the following, as complying with ASTM C171.
 1. Polyethylene Film (Clear or White Opaque).
 2. White-Burlap-Polyethylene Sheet.
 3. Reinforced Curing Paper (Regular or White).
 4. Liquid Membrane-Forming Concrete Curing Compound: Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings. Clear Solvent-Borne Liquid Membrane-Forming Curing Compound: Spray-applied, ready-to-use, meeting ASTM C309, Type I, Class B.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *AH Curing Compound #2 DR*, Anti-Hydro International, Inc.
 - 2) *Res-X Cure All Resin*, Burke Group, LLC.
 - 3) *RX Cure*; Conspec Marketing & Manufacturing Co., Inc.
 - 4) *Day-Chem Rez Cure*, Dayton Superior Corporation.
 - 5) *Kurez DR*, Euclid Chemical Co.
 - 6) *Nitocure S*, Fosroc.
 - 7) *#64 Resin Cure*, Lambert Corporation.
 - 8) *L&M Cure DR*, L&M Construction Chemicals, Inc.
 - 9) *3100-Clear*, W. R. Meadows, Inc.
 - 10) *Seal N Kure FDR*, Metalcrete Industries.
 - 11) *Rich Cure*, Richmond Screw Anchor Co.
 - 12) *Resi-Chem C309*, Symons Corporation.
 - 13) *Horncrete 30*, Tamms Industries Co., Div. of LaPorte Construction Chemicals N.A., Inc.
 - 14) *Uni Res 150*, Unitex.
 - 15) *Certi-Vex RC*, Vexcon Chemicals, Inc.
 - 16) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Per selected Manufacturer's latest printed instructions.
 5. Clear Water-Borne Membrane-Forming Curing Compound: Spray-applied, ready-to-use, meeting ASTM C309, Type I, Class A.

- a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *AH Curing Compound #2 DR WB*, Anti-Hydro International, Inc.
 - 2) *Spartan-Cote*, Burke Group, LLC.
 - 3) *Safe-Cure Clear*, ChemMasters.
 - 4) *W.B. Resin Cure*, Conspec Marketing & Manufacturing Co., Inc.
 - 5) *Day Chem Rez Cure (J-11-W)*, Dayton Superior Corporation.
 - 6) *Cure & Seal 30 EF*, Conspec, Dayton Superior Corporation.
 - 7) *Nitocure S*, Fosroc.
 - 8) *Aqua Kure-Clear*, Lambert Corporation.
 - 9) *L&M Cure R*, L&M Construction Chemicals, Inc.
 - 10) *1100 Clear*, W. R. Meadows, Inc.
 - 11) *Resin Cure E*, Nox-Crete Products Group, Kinsman Corporation.
 - 12) *Rich Cure E*, Richmond Screw Anchor Co.
 - 13) *Resi-Chem Clear Cure*, Symons Corporation.
 - 14) *Horn cure 100*, Tamms Industries Co., Div. of LaPorte Construction Chemicals N.A., Inc.
 - 15) *Hydro Cure*, Unitex.
 - 16) *Certi-Vex Enviocure*, Vexcon Chemicals, Inc.
 - 17) *Clear-Seal 150*, A.C. Horn.
 - 18) *Master Seal*, Master Builders.
 - 19) *Kure-N-Seal*, Sonneborn.
 - 20) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Per selected Manufacturer's latest printed instructions.
6. White Water-Borne Membrane-Forming Curing Compound: Spray-applied, ready-to-use, meeting ASTM C309, Type II, Class B.
- a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *AH Curing Compound #2 WB WP*, Anti-Hydro International, Inc.
 - 2) *Aqua Resin Cure*, Burke Group, LLC.
 - 3) *W.B. Resin Cure*, Conspec Marketing & Manufacturing Co., Inc.
 - 4) *Thinfilm 450*, Kaufman Products, Inc.
 - 5) *Aqua Kure-White*, Lambert Corporation.
 - 6) *L&M Cure R-2*, L&M Construction Chemicals, Inc.
 - 7) *1200-White*, W. R. Meadows, Inc.
 - 8) *White Pigmented Resin Cure E*, Nox-Crete Products Group, Kinsman Corporation.
 - 9) *Rich Cure White E*, Richmond Screw Anchor Co.
 - 10) *Resi-Chem High Cure*, Symons Corporation.
 - 11) *Horn cure 200-W*, Tamms Industries Co., Div. of LaPorte Construction Chemicals N.A. Inc.
 - 12) *Hydro White 309*, Unitex.
 - 13) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Per selected Manufacturer's latest printed instructions.
- C. Liquid Membrane-Forming Concrete Curing and Sealing Compound: <<<SELECT TYPE>>>
Applied to fresh concrete immediately after the disappearance of the surface water sheen. Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
1. Spray-applied, ready-to-use, meeting ASTM C1315, Type I, Class A, with maximum water loss .40kg/m² in 72 hours when applied @300ft²/gal.; minimum solids content of 25%.

2. Spray-applied, ready-to-use, meeting ASTM C1315, Type II, Class A, with maximum water loss .40kg/m² in 72 hours when applied @300ft²/gal.; minimum solids content of 25%.
- D. Evaporation Retarder: Waterborne, spray-applied, ready-to-use, mono-molecular film-forming compound, formulated to be applied to fresh concrete surfaces, for temporary protection from rapid moisture loss. Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Cimfilm*, Axim Concrete Technologies.
 - b. *Finishing Aid Concentrate*, Burke Group, LLC.
 - c. *Spray-Film*, ChemMasters.
 - d. *Aquafilm*, Conspec Marketing & Manufacturing Co., Inc.
 - e. *Sure Film*, Dayton Superior Corporation.
 - f. *Eucobar*, Euclid Chemical Co.
 - g. *Vapor Aid*, Kaufman Products, Inc.
 - h. *Lambco Skin*, Lambert Corporation.
 - i. *E-Con*, L&M Construction Chemicals, Inc.
 - j. *Confilm*, Master Builders, Inc.
 - k. *Waterhold*, Metalcrete Industries.
 - l. *Rich Film*, Richmond Screw Anchor Co.
 - m. *SikaFilm*, Sika Corporation.
 - n. *Finishing Aid*, Symons Corporation.
 - o. *Certi-Vex EnvioAssist*, Vexcon Chemicals, Inc.
 - p. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Per selected Manufacturer's latest printed instructions.
- E. Surface Set-Retarder: Spray-applied, ready-to-use, water-based solution with color dye, non-staining, non-corrosive, non-flammable, non-toxic, specifically formulated to retard the set of fresh concrete surfaces, temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch (to expose the surface aggregates). Material shall meet the maximum Volatile Organic Compound (VOC) content of 350 g/L for concrete curing compounds as required by the U.S. EPA Architectural Coatings Rule and shall be VOC-compliant for the State of California Regulation 8, Organic Compounds, Rule 3, Architectural Coatings.
1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Top-Cast™*, Grace Construction Products, Inc.
 - b. *TK6000 Concrete Surface Retarder*, TK Products.
 - c. *Top-Etch Surface Retarder*, Unitex Chemicals.
 - d. *R-30 Surface Retarder*, Specco Industries.
 - e. *Certi-Vex Envio Set*, Vexcon Chemicals, Inc.
 - f. *True Etch Surface Retarder*, Burke Group, LLC.
 - g. *Exposee*, ChemMasters.
 - h. *Delay S*, Conspec Marketing & Manufacturing Co., Inc.
 - i. *Concrete Surface Retarders*, Euclid Chemical Co.
 - j. *Expose*, Kaufman Products, Inc.
 - k. *Surftard*, Metalcrete Industries.
 - l. *Crete-Nox TA*, Nox-Crete Products Group, Kinsman Corporation.
 - m. *Lithotex*, L. M. Scofield Co.
 - n. *Rugasol-S*, Sika Corporation.
 - o. *Certi-Vex EnvioSet*, Vexcon Chemicals, Inc.

- p. *Atlas Top Etch*, Atlas Tech Products.
- q. Or equal, as approved by the Landscape Architect.
- 2. Application Rate: Per selected Manufacturer's latest printed instructions.

- F. Spray applied, film forming protective coating, for surfaces adjacent to Set-Retarded finish surfaces.
 - 1. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Face Off*, Grace Construction Products, Inc.
 - b. Or equal, as approved by the Landscape Architect.

7. RELATED MATERIALS

- A. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- B. Epoxy Bonding Adhesive: ASTM C881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:
 - 1. Type II, non-load bearing, for bonding freshly mixed concrete to hardened concrete.
 - 2. Types I and II, non-load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
 - 3. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
- C. Sand for covering Vapor Barrier: Clean, hard, durable, natural Sand, conforming to ASTM C33.
- D. Expansion Joint Materials:
 - 1. Expansion Joint-Filler Strips:
 - a. Asphalt-Saturated Cellulosic Fiber, meeting ASTM D1751, with "guide strip" removable depth gauge cap. Expansion Joint-Filler Strip shall be versatile, resilient, flexible and non-extruding. When compressed to half of its original thickness, it shall recover to a minimum of 70% of its original thickness.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Sealtight Fibre with Snap Cap*, WR Meadows.
 - b) *Fiber Board*, APS Supply.
 - c) Or equal, as approved by the Landscape Architect.
 - 2) Thickness/Width: As indicated on the Contract Drawings.
 - b. Clean selected Granulated Cork, bonded with a phenolic resin, meeting ASTM D1752, with "guide strip" removable depth gauge cap.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Sealtight Standard Cork*, WR Meadows.
 - b) *Standard Cork Expansion Joint Filler*, APS Supply.
 - c) Or equal, as approved by the Landscape Architect.
 - 2) Thickness/Width: As indicated on the Contract Drawings.
 - c. Self-sealing, non-absorbent Asphalt, meeting ASTM D 944. Installed at 1/4" below the finished surface, a joint sealant is not required.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *SealTight Asphalt*, WR Meadows.
 - b) Or equal, as approved by the Landscape Architect.
 - 2) Thickness/Width: As indicated on the Contract Drawings.

2. Joint Sealant Backing:
 - a. General: Provide Joint Sealant Backings which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved by sealant manufacturer.
 - b. Plastic Foam Joint-Fillers: Preformed, compressible, resilient, non-waxing, non-extruding strips of closed cell plastic foam, of size, shape and density to control sealant depth.
 - c. Bond Breaker: Pressure-sensitive tape, as recommended by Joint Sealant manufacturer, to suit application.
 3. Miscellaneous Joint Sealant Materials:
 - a. Primer: As recommended by joint sealant Manufacturer for adhesion of sealant to joint substrates.
 - b. Cleaners for Nonporous Surfaces: Nonstaining, chemical cleaner of type acceptable to manufacturer of sealant and sealant backing materials which are not harmful to substrates and adjacent nonporous materials.
 - c. Masking Tape: Non-staining, nonabsorbent type compatible with joint sealants and to surfaces adjacent to joints.
 4. Joint Sealant:
 - a. Vertical Applications: Meet ASTM C920, Type S, Grade P, Class 25, Use T, Low-VOC, cold-applied, elastomeric polyurethane Joint Sealant for exterior applications. Color to match adjacent color finish.
 - 1) Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) Sika Corporation.
 - b) Tremco, Inc.
 - c) Sonneborn.
 - d) Pecora Corporation.
 - e) or equal, as approved by the Landscape Architect.
- E. Vapor Barrier:
1. Meet ASTM E1745 Class A, as tested through ASTM E154. Polyethylene sheeting, transparent, ten (10) mil. thickness minimum, with impact strength (resistance to puncture) greater than 70 grams/mil., 10'-0" minimum width, and minimum baseline water vapor permeance of .015 perms, as tested per ASTM E96, Procedure B. Provide minimum 2" wide waterproof, polyethylene tape, with rubber-based pressure sensitive self-adhering tape matrix, for sealing edges and ends of sheeting.
 2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *10 mil Stego Wrap*, Stego Industries.
 - b. *Rafco 400*, Raven Industries.
 - c. *Moistop*, Fortifiber Corp.
 - d. *Nervastral Barrier*, Rubber and Plastics Compound, Co.
 - e. *Vinyl Water Barrier*, B.F. Goodrich Corp.
 - f. Or equal, as approved by the Landscape Architect.
- F. Cold Fluid-Applied Waterproofing: Refer to Section 071416 – Cold Fluid Applied Waterproofing for requirements.
8. CONCRETE MIXES AND PROPORTIONING
- A. Proportion and mix of cement, aggregate, admixture and water to attain required plasticity and strength for each type of normal-weight concrete in accordance with current edition of ACI's "*Manual of Concrete Practice*" and the PCA's "*Design and Control of Concrete Mixtures*."

1. Use transit mixer trucks equipped with automatic devices for recording number of revolution of drum.
 - B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method, using approved materials to obtain specified minimum compressive strength.
 1. Do not use the Owner's field quality-control testing agency as the independent testing agency.
 - C. Slump: Adjust quantity of water so concrete at point and time of discharge does not exceed the aforementioned slumps when tested per ASTM C143. Use the minimum water necessary for workability required by part of item being cast.
 - D. Proportion Concrete Mixes to provide Concrete with the following properties:
 1. Site Concrete:
 - a. Compressive Strength (at 28 Days): Minimum 3,000 PSI.
 - b. Maximum Slump Limit: Five-inches (5") at point of discharge, with a 1/2-inch slump differential between successive batches. Obtain approval from the Landscape Architect if slump is outside these parameters.
 - c. Maximum Water/Cementitious Materials Ratio: .50.
 - d. Cement Content: Minimum six (6)- sack mix (564 lbs. cement per cubic yard).
 - E. Cementitious Materials: Limit percentage, by weight, of cementitious materials (other than Portland Cement) in concrete as follows:
 1. Fly Ash: Provide ten-percent (10%) maximum content.
 - F. Add Air-Entraining Admixture at the Manufacturer's prescribed rate to result in concrete at point of placement having an air content of 2.5 to 4.5 percent.
 - G. Coloring Agent: Add coloring agent to mix according to Manufacturer's written instructions.
 - H. Non-Chloride Accelerators: Do not use corrosive accelerators such as calcium chloride.
 - I. Concrete Delivery: Use of concrete loads exceeding ninety (90) minutes from time of batch plant must be approved by the Landscape Architect.
 - J. Ensure that the batch plant guarantees a single-source supply for cementitious materials and aggregates (coarse and fine) for the entire project.
9. CONCRETE MIXING
- A. Ready-Mixed Concrete: Comply with requirements and with ASTM C94.
 - B. When air temperature is between 85 deg. F. (30 deg. C) and 90 deg F (32 deg. C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
10. SITE CONCRETE SEALANTS
- A. Penetrating Concrete Sealer:
 1. Applications: Refer to the Site Concrete Schedule indicated herein this Section for requirements.

2. General: Penetrating Concrete Sealer shall be an invisible, water-based penetrating Sealer, used to protect exterior cast-in-place site concrete installations. Sealer shall be a clear, non-flammable, UV-stabilized, non-yellowing solution which cures to reduce staining, soiling, discoloration, efflorescence, and acts as a invisible water-repellant coating, formulated to impart water repellence and dirt reduction to concrete surfaces with no change in the surface appearance. Sealer shall react with carbon dioxide, and atmospheric moisture to form a penetrating water, dirt and mildew repellent barrier within 24 hours. Moisture absorption rate shall be low to reduce visible surface changes for up to ten (10) years.
 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Sinak Sealer S-101*, Sinak Corporation.
 - b. *Natural Look Penetrating Sealer*, Glaze 'N Seal.
 - c. *Sure Klean Weather Seal SL100*, Prosoco Inc.
 - d. *Repello*, LM Scofield.
 - e. Or equal, as approved by the Landscape Architect.
- B. Multi-Purpose Water-Based (Film-forming) Sealer:
1. Applications: Refer to the Site Concrete Schedule indicated herein this Section for requirements.
 2. General: Multi-Purpose Water-Based (Film-forming) Sealer shall be a clear, acrylic, non-flammable, non-yellowing, UV-stabilized, water-based Sealer, designed to protect and beautify exterior site concrete finishes. Applied by spray or brush in light, even coats, Sealer shall penetrate the surface to give a semi-gloss finish. Sealer shall protect concrete surfaces against organic stains, including oil, grease, and beverages.
 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Cureseal (Semi-Gloss)*, L.M. Scofield Company.
 - b. *Multi-Purpose Water-Based Sealer*, Glaze 'N Seal.
 - c. *Atlas Outshine Sealer*, Atlas Tech Products.
 - d. Or equal, as approved by the Landscape Architect.
- C. Multi-Purpose Solvent-Based (Film-forming) Sealer:
1. Applications: Refer to the Site Concrete Schedule indicated herein this Section for requirements.
 2. General: Multi-Purpose Solvent-Based (Film-forming) Sealer shall be a clear, acrylic, non-yellowing, UV-stabilized, low VOC solvent-based lacquer sealer designed to protect and beautify exterior site concrete finishes. Applied by spray or brush in light, even coats, Sealer shall penetrate the surface to give a "wet-look" gloss finish. Sealer shall protect concrete surfaces against organic stains, including oil, grease, and beverages.
 3. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Wet Look 2000 Lacquer*, Glaze 'N Seal.
 - b. *Atlas Cure & Seal 30%*, Atlas Tech Products.
 - c. Or equal, as approved by the Landscape Architect.

3.EXECUTION

1. EXAMINATION

- A. Proof-roll prepared sub-base surface for foundations to check for unstable areas and verify need for additional compaction. Verify that sub-grade preparation for site concrete has been completed including base course prior to commencement of Work.
- B. Surface Drainage:
 - 1. Report in writing conflicts discovered on the site or prior Work done by others, which would prevent positive drainage.
 - 2. Do not permit finished site concrete surfaces to vary more than 1/4 in. measured with a 10 ft. metal straightedge, except at grade changes. Properly correct irregularities.

2. PREPARATION

- A. Templates: Use templates for anchor plates, bolts, inserts and/or other items embedded in concrete. Accurately secure so that they will not be displaced during placing of concrete.
- B. Piping and Conduit: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures at maximum. Verify size, length and location of electrical conduit.
- C. Aggregate Base Course: Compact base course to thicknesses as shown on Contract Drawings or as indicated per the Geotechnical Report, to the relative compaction density as required per the Geotechnical Report. Aggregate Base Course shall be graded to the lines and levels indicated; no ruts or depressions shall be allowed.
- D. Gravel Fill or Sand Beds: Re-compact disturbed gravel fill or sand beds and bring to correct elevation.
- E. Vapor Barrier
 - 1. Install, protect, and repair Vapor Barrier sheets according to ASTM E1643. Place sheets in position with longest dimension parallel with direction of pour.
 - 2. Lap joints six-inches (6") and seal with Manufacturer's recommended tape.
 - 3. Cover Vapor Barrier with a two-inch (2") layer of clean damp sand.

3. FORMWORK

- A. Design, construct, erect, shore, brace, and maintain Formwork according to ACI 347 *"Guide to Formwork for Concrete."*
- B. Formwork shall be consistent with the orientation and pattern indicated on the Contract Drawings. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install Formwork to allow continuous progress of Work and so that Formwork can remain in place at least twenty-four (24)-hours after concrete placement.
- C. Coordinate locations of drainage piping requirements, irrigation piping stub-outs, electrical conduits, or other items scheduled to be embedded into cast concrete.
- D. Check completed Formwork and screeds for grade and alignment to following tolerances:
 - 1. Top of Forms: Not more than 1/8 inch in ten- (10) feet.
 - 2. Vertical Face on Longitudinal Axis: Not more than 1/4 inch in ten-(10) feet.

- E. Coat Form Work with Form Release Agent, as required, to ensure Form Work separates from casted Site Concrete without damage to concrete's finished surface.
 - 1. Formwork surfaces shall be clean, dry, and free from contaminants (dirt, dust, rust, build-up, and existing form agents) prior to each use of Formwork
 - 2. Prior to each use, Formwork that comes into direct contact with concrete shall be coated with Form Release Agent in accordance with the Manufacturer's written instructions.
 - 3. Apply Form Release Agent in a uniform and even manner by low pressure spray, roller, or clean cloth, in accordance with the Manufacturer's written instructions.
 - 4. Prior to coating new Formwork, apply one (1) or two (2) heavy coats to edges for waterproofing protection.
 - 5. Excess Form Release Agent or dense form surfaces should be removed with a clean cloth.
 - 6. Do not apply Form Release Agent to Reinforcement.
- F. Screeds:
 - 1. Set screeds at maximum 8'-0": centers between. Set to provide at grades per Contract Drawings. Check with an instrument level, transit, or laser during placing operations to maintain desired grades.
 - 2. Screeds over Vapor Barriers: Use weighted pad or cradle-type screeds and do not drive stakes through the vapor barrier. Check with an instrument level, transit, or laser.

4. STEEL REINFORCEMENT

- A. General: Comply with CRSI's *"Manual of Standard Practice"* for fabricating reinforcement and with recommendations in CRSI's *"Placing Reinforcing Bars"* for placing and supporting reinforcement.
- B. Clean Reinforcement of loose rust and mill scale, earth, or other bond-reducing materials.
- C. Arrange, space, and securely Tie Bars and Bar Supports to firmly hold and support the Steel Reinforcement in position during concrete placement and to prevent displacement before or during casting. Maintain a minimum of two inches (2") cover to the Reinforcement.
- D. Install Steel Reinforcement Bars in sizes as indicated on the Contract Drawings, in lengths as long as practicable. Lap adjoining Bars at a minimum of fifty (50) bar diameters. Lace splices accordingly with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Reinforcement Bars on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Reinforcement Bars through expansion joints.
- E. Install Welded Wire Reinforcement (where required) in sizes as indicated on the Contract Drawings, in continuous lengths as long as practicable. Lap adjoining pieces at least one-one half (1-1/2) courses of the full fabric mesh, and a minimum of six-inches (6"). Lace splices with Tie Wire. Offset laps of adjoining widths to prevent continuous laps in either direction. Erect and maintain Fabric on chairs, secured firmly in position, in the middle of the concrete during casting operations. Do not extend Welded Wire Fabric through expansion joints.
- F. Install Construction Joint Dowel Bars & Sleeves per the Manufacturer's recommendation. Reinforcing dowels, or sleeves for the reinforcing dowels, shall be secured in place prior to placing concrete. Align dowels in straight, even alignments in the middle of the concrete profile during casting operations. Dowels and sleeves shall not be pressed into the concrete during casting and after the concrete has been placed.

- G. Install fabricated Steel 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 two-inch (2") overlap to adjacent mats.
- H. Apply epoxy repair coating to uncoated or damaged surfaces of epoxy-coated reinforcement, as required.
- I. Vapor Barrier: If provided, do not cut or puncture Vapor Barrier. Repair damage and reseal Vapor Barrier before placing concrete.

5. CONCRETE PLACEMENT

- A. General: Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.
- B. Preparation: Remove all free water from forms before concrete is deposited. Remove hardened concrete, debris, and foreign materials from interior surfaces of forms, exposed reinforcing, and from surfaces of mixing and conveying equipment.
- C. Sub-Base: Sub-Base shall be free of ruts, holes, ridges, etc. Smooth and compact sub-base to an even plane.
- D. Wetting: Wet wood forms sufficiently to tighten up cracks. Wet other materials sufficiently to reduce absorption and to help maintain concrete workability. Dampen earth sub-grade twenty-four (24) hours before placing concrete, but do not muddy. Re-roll where necessary for smoothness, and remove loose material from compacted sub-base surface prior to placing concrete.
- E. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, dowels/sleeves, and items to be embedded or cast in. Notify other trades to permit installation of their Work.
 - 1. Reinforcement and Forms shall be secured firmly in position such that they will not be displaced during the placement of concrete.
 - 2. Reinforcement Bars, Ties, and Welded Wire Reinforcement shall be completely encased in concrete, at a minimum of two-inches (2") from any edge of the concrete.
 - 3. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.
- 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. Reinforcement shall be secured firmly in position on chairs in the middle of the site concrete during casting operations. Should reinforcement come loose from the chairs, pull reinforcement into position as the concrete is placed by means of hooks. Concrete shall be worked under the steel to insure that it is at the proper distance in the middle of the site concrete.
- H. Consolidate site concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.
 - 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.

- I. Screed surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations.
- J. When adjoining concrete lanes are placed in separate pours, do not operate equipment on concrete until concrete has attained eighty-five-percent (85%) of its fully hydrated compressive strength.
- K. Cold-Weather Placement: Comply with ACI 306.1, and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When air temperature has fallen to or is expected to fall below 40 deg. F. (4.4 deg. C.), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg. F. (10 deg. C.) and not more than 80 deg. F. (27 deg. C.) at point of placement.
 - 2. Do not use calcium chloride, salt, or other materials containing anti-freeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.
- L. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:
 - 1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg. F. (32 deg. C.). Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
 - 3. Fog-spray forms, reinforcement steel, and sub-grade just before placing concrete. Keep sub-grade moisture uniform without standing water, soft spots, or dry areas.

6. JOINTS

- A. General: Refer to ACI 302 *"Guide for Concrete Floor and Slab Construction"* for work under this Article. Construct construction, isolation, expansion, and contraction joints and tool edgings 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 site concrete and at locations where site concrete operations are stopped for more than one-half (1/2) hour, unless site concrete terminates at isolation joints.
 - 1. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of site concrete strips, unless otherwise indicated on the Contract Drawings.
 - 2. Provide tie bars at sides of site concrete strips where indicated.
 - 3. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Expansion Joints: Form expansion joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, buildings, foundations, walls, other fixed objects, and in other locations as indicated on the Contract Drawings. Provide Expansion

Joints at full depth of Site Concrete where Site Concrete meets vertical faces of buildings, structures, foundations, walls, etc.

1. Locate expansion joints at maximum intervals of twenty (20) feet, unless otherwise indicated on the Contract Drawings.
2. Extend joint fillers full width and depth of joint.
3. Provide Construction Joint Dowel Bars at the spacing distances indicated in the Contract Drawings.
4. Terminate Joint Filler less than 1/2 inch or more than one-inch (1") below finished surface if joint sealant is indicated.
5. Place top of Joint Filler flush with finished concrete surface if joint sealant is not indicated.
6. Furnish joint fillers in one (1)-piece lengths. Where more than one (1) length is required, lace or clip joint-filler sections together.
7. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Contraction Joints and Isolation Joints: Form weakened-plane contraction joints and isolation joints, sectioning concrete into areas as indicated on the Construction Drawings, or at spacing intervals as recommended by the PCA.

1. General Methodology: Contraction Joints shall be placed in Site Concrete to minimize the occurrence of random cracking on the surface due to drying shrinkage or stress loading and to reduce the width of concrete cracks should they occur. When not indicated on the Contract Drawings, Contraction Joints shall be placed at 24x the thickness of the site concrete.
2. Tooled (Grooved) Contraction Joints:
 - a. Form Tooled (Grooved) Joints in fresh concrete after initial floating using a jointer to cut the above the groove so that a smooth, uniform impression is obtained. Strike joints before and after floating and troweling.
 - b. Perform in a continuous operation to avoid misalignment of joints. Use snap-lines and forms, as required, to achieve consistent lines. Re-form crooked or misaligned joints at no cost to Owner.
 - c. Radius of Joint Tool:
 - 1) Radius: 1/8 inch.
 - 2) Radius: 1/4 inch
 - d. Depth: Construct depth equal to a minimum of one-fourth (1/4) of the concrete slab thickness.
3. Saw-Cut Contraction Joints:
 - a. Construct Saw-Cut Contraction Joints with a circular power saw, equipped with a new, shatterproof abrasive or diamond-tipped blade. Cut 3/16-inch-wide joints (maximum width of saw-blade) into concrete surface. Cutting action shall not tear, abrade, spall, shatter, or otherwise damage the surface.
 - b. Saw-cut concrete surface when successful jointing results can be achieved and prior to uncontrolled random contraction cracking of concrete occurs.
 - 1) Early-entry Saw cuts: When used, provide saw cuts into fresh concrete at 1" to 1-1/4" depth, or as indicated on the Contract Drawings.
 - c. Perform saw-cut joints cleanly and smoothly, to a constant and equal depth, in a continuous consistent line, with no over-cutting.
 - d. Depth:
 - 1) Contraction Joints: Construct depth equal to a minimum of one-fourth (1/4) of the concrete slab thickness.
 - 2) Isolation Joints: Construct depth equal to the full depth of the concrete thickness.

- e. Perform in as continuous an operation as possible, to avoid misalignment of joints. Use chalk lines, forms, or templates as required, to achieve consistent lines)
 - f. Use a hand grinder with a four-inch (4") diamond blade to saw-cut up to vertical edges such as walls, steps, curbs and columns. Do not over-cut into vertical surfaces or adjacent concrete surfaces.
- E. Edging: Tool edges of site concrete, as required, after initial floating, with an edging tool to the following radius or chamfer. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on Site Concrete surfaces.
- 1. Radius: 1/4 inch (aka "Carpet Edger").
 - 2. Chamfer: 1/2" inch.

7. CONCRETE FINISHES

A. General:

- 1. Any exposed Site Concrete surfaces that are subject to pedestrian traffic shall be "slip-resistant", per the requirements outlined in CBC, Section 1124B.1, and per ADAAG 4.5.1.
 - a. The minimum coefficient of friction shall meet or exceed 0.8 on exterior and 0.6 on interior surfaces.
 - b. Exposed Site Concrete surfaces shall have the following finish on all surfaces less than six percent (6%) slope:
 - 1) Medium Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Medium Broom Textured Finish.
 - c. Exposed Site Concrete surfaces shall have the following finish on all surfaces greater than six percent (6%) slope:
 - 1) Heavy Broom Textured Finish, or a textured finish as specified which is equivalent to the finished texture of a Heavy Broom Textured Finish.
 - d. Color(s) and finish(es) specified herein shall match referee samples and field-constructed mock-up samples as approved by the Landscape Architect.
 - e. Wetting of concrete surfaces during screeding, initial floating, or finishing operations is strictly prohibited.

B. Buff-Washed/Rubbed Texture Finish: Conform to ACI 301. Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish appearance, and other characteristics relating to aesthetic effects.

- 1. Applications: Refer to the Cast-in-Place Site Concrete Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings.
- 2. Performance Standard: An evenly consistent, uniformly-colored and -textured surface finish that exposes the fine aggregates evident in the concrete slurry mix which is devoid of visible surface defects is the intent of this Specification. Contractor shall deliver a Site Concrete finish that is true to plane which is free from any exposed surface bug holes, honeycombing, rock pockets, air voids, formwork texture transfer, form-tie holes, visible construction joints, fins, burrs, and shrinkage cracks.
- 3. Provide contraction jointing and edging, as required, in the locations indicated in the Contract Drawings, and of the type(s) indicated herein this Section. Early-entry jointing of concrete may be required to prevent premature cracking of finished surfaces
- 4. Once concrete has been consolidated, floated, the bleed-water sheen has disappeared, and the Site Concrete has stiffened sufficiently, remove formwork. Do not remove formwork prematurely.
- 5. Remove snap ties and plastic tie cones used in the concrete formwork from the surface.

6. Using the same cement slurry as used in the Site Concrete application, carefully sack and patch the surface voids from the formwork, any exposed honeycombing, bug holes, or shrinkage cracks that are evident after form removal.
 7. With a hose or hand sprayer, lightly mist the exposed surfaces of the Site Concrete with water. Carefully remove the exposed Site Concrete Surfaces through a process of gently brushing surface with a fine nylon bristle brush or sponge, to lightly expose the fine aggregates (sand) at the surface of the Site Concrete. Repeat the water misting and brushing/sponging cycles, as needed, until the surface texture uniform in appearance.
 8. Apply curing methods.
 9. After concrete is fully hydrated (approx. 30-days), seal the exposed Site Concrete finished surfaces with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Cast-in-Place Concrete Paving Schedule indicated herein this Section for Sealer requirements.
- C. Sandblast Textured Finish: <<<VERIFY>>> Match Referee Sample, as acquired by the Landscape Architect, and the approved Field Constructed Mock-up, to compare for color, texture, finish appearance, and other characteristics relating to aesthetic effects.
1. Applications: Refer to the Site Concrete Schedule indicated herein this Section for requirements. Provide in areas as indicated on Contract Drawings. <<<VERIFY>>>
 2. Work shall conform to CAL OSHA /MSDS for application and clean up procedures.
 3. After concrete is fully hydrated (approx. 30-days), provide a sandblast-textured finish to the exposed concrete surfaces, revealing the desired aggregates, with the following surface texture:
 - a. Light Sandblast Texture.
 - b.
 4. Provide jointing in the locations indicated in the Contract Drawings.
 5. Seal sandblast texture finished concrete surface with two (2) coats of Sealer as specified herein this Section, per the Manufacturer's latest printed instructions.
 - a. Refer to the Site Concrete Schedule indicated herein this Section for Sealer requirements.
8. SITE CONCRETE PROTECTION AND CURING
- A. General: Protect freshly placed Site Concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.
- B. Evaporation Retarder: Apply Evaporation Retarder to Site Concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Concrete Curing:
1. General: Meet ACI Standard ACI 308R. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
 2. Method: Cure concrete by Direct Moisture Curing, Absorptive Cover Curing, Moisture-Retaining-Cover Curing, Curing Compound application, Curing and Sealing Compound application, or a combination of these, as follows:
 - a. Direct Moisture Curing: Keep surfaces continuously moist for not less than seven (7) days with the following materials:
 - 1) Water.
 - 2) Continuous water-fog spray.

- b. Absorptive Cover Curing: Cover concrete surfaces with water saturated Absorptive Cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least twelve inches (12"). Immediately repair any holes or tears during curing period using cover material and tape. Keep Cover continuously moist for not less than seven (7) days.
- c. 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 twelve inches (12") and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Keep Moisture-Retaining-Cover continuously moist for not less than seven (7) days.
- d. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to Manufacturer's written instructions. Re-coat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.
- e. Curing and Sealing Compound: Apply uniformly in continuous operation by power spray or roller according to Manufacturer's written instructions. Re-coat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.

9. INSTALLATION OF JOINT SEALANTS

- A. Provide a Joint Sealant that is compatible with the substrate material(s) to which it is being applied. Do not use a Joint Sealant that has exceeded shelf life or has jelled and cannot be discharged in a continuous flow from the application tool.
- B. Ambient Temperature Criteria: The ambient temperature shall be within the limits of 40d. F. and 90d. F. when the Joint Sealant is being applied.
- C. Sealant Installation Standard: Comply with recommendations of ASTM C1193 for use of Joint Sealants as applicable to materials, applications, and conditions indicated.
- D. Surface Preparation of Joints:
 - 1. Remove foreign material from joint substrates which could interfere with adhesion of Joint Sealant, including dust, surface dirt, dirt, moisture, water repellents, grease, oil, wax, lacquer, paint, waterproofing, or other foreign matter that would tend to destroy or impair adhesion.
 - 2. Remove oil and grease with solvent. Surfaces must be wiped dry with clean cloths.
 - 3. Clean porous surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or acid washing to produce a clean, sound substrate. Remove loose particles remaining from cleaning operations by vacuuming or blowing out joints.
 - 4. Where surfaces have been treated with curing compounds, oil, or other such materials, remove materials by sandblasting or wire brushing.
 - 5. Clean nonporous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of Joint Sealants.
- E. Sealant Preparation: Do not add liquids, solvents, or powders to the Joint Sealant material (for single-component materials). Where specified, mix multi-component elastomeric Joint Sealants in accordance with manufacturer's instructions.
- F. Primer: Immediately prior to application of the Joint Sealant, clean out loose particles from joints. Where recommended by the sealant manufacturer, apply Primer to joints in accordance

with sealant manufacturer's instructions. Do not apply Primer to exposed finish surfaces. Do not allow spillage or migration of Primer onto adjoining surfaces.

- G. Installation of Sealant Backings: Install sealant backings to comply with the following requirements:
1. Install Joint Fillers to provide sealant support for optimum performance crosssectional shapes and depths.
 - a. Do not leave gaps between ends of Joint Fillers.
 - b. Do not stretch, twist, puncture or tear Joint Fillers.
 - c. Remove absorbent Joint Fillers which have become wet prior to sealant application and replace with dry material.
 2. Install Bond Breaker to the back or bottom of the joint cavity (between sealants and jointfillers, compression seals or back of joints where required), as recommended by the Joint Sealant manufacturer, for each type of joint and sealant used, to prevent "third-side" adhesion of the Joint Sealant to the back of the joint. Carefully apply the Bond Breaker to avoid contamination of adjoining surfaces or breaking bond with surfaces other than those covered by the Bond Breaker.
- H. Installation of Joint Sealants:
1. Install Joint Sealant after concrete substrate material has been cast and allowed to cure. Remove protective cap from preformed Joint Filler. Remove any excess Joint Filler material that will inhibit an adequate depth and bond of the Joint Sealant material.
 2. Place masking tape where required along the joint cavity to prevent contact of the Joint Sealant with adjoining surfaces. Remove masking tape within ten (10) minutes after joint has been filled and tooled.
 3. Apply the Joint Sealant in accordance with the manufacturer's printed instructions with an application tool having a nozzle that fits the width of the joint cavity. Install Joint Sealant by proven techniques to contact and solidly full wet joint substrates, completely filling the recesses provided for each joint configuration, providing uniform, optimum performance crosssectional shapes and depths. Do not allow spillage or migration of Joint Sealant onto adjoining surfaces.
- I. Tooling of Non-Sag Joint Sealants: Tool Non-Sag Joint Sealants to form smooth, uniform beads of configuration indicated, free of wrinkles, streaks, gouges, boils, air holes, etc. and to ensure contact and adhesion of the Joint Sealant with the sides of the joint. Remove excess Joint Sealants from surfaces adjacent to joint. Do not use tooling agents which discolor Joint Sealants or adjacent surfaces or are not approved by Sealant Manufacturer.
- J. Sanding of Joint Sealant: Lightly apply dry sand to cover freshly-poured elastic Joint Sealant material. When Joint Sealant has hardened, remove excess sand that has not bonded to Joint Sealant.
- K. Protection and Curing:
1. Protect installed Joint Sealants during and after curing period from contact with contaminating substances or from damage.
 2. Cut out and remove damaged or deteriorated Joint Sealers and reseal joints with matching new materials.
 3. Clean off excess Joint Sealants or sealant smears adjacent to joints as Work progresses by methods and with cleaning materials approved by the Sealant Manufacturer.

10. APPLICATION OF CONCRETE SEALANTS

- A. Penetrating Concrete Sealer: After cast-in-place concrete is fully hydrated (approx. 30-days), seal exposed site concrete surfaces with two (2) coats of approved Penetrating Concrete Sealer. Apply in accordance with Manufacturer's written directions. Finished surfaces shall be uniform in appearance and not mottled.

11. SITE CONCRETE TOLERANCES

- A. General: Comply with ACI 117 – *Standard Specifications for Tolerances for Concrete Construction and Materials*, and as follows:
1. Elevation: 1/4 inch.
 2. Thickness: Plus 3/8 inch, minus 1/4 inch.
 3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch. Variation from the Level or from the Grades shown, per Civil Engineer Drawings:
 - a. In pavements:
 - 1) In any ten-feet (10'): 1/4 inch.
 - 2) In twenty-feet (20'): maximum 3/8 inch.
 - 3) In forty-feet (40') or more: 3/4 inch.
 - b. Variation in Radii:
 - 1) In radii of less than ten-feet (10'):
 - a) In any five-feet (5'): 1/8 inch.
 - b) In any ten-feet (10'): 1/4 inch.
 - 2) In radii of twenty feet (20'):
 - a) In any ten-feet (10'): 1/4 inch.
 - b) In any twenty-feet (20'): 3/8 inch.
 - 3) In radii of thirty-feet (30'), or more:
 - a) In any twenty-feet (20'): 1/2 inch.
 - b) In any thirty-feet (30'): 1 inch.
 4. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch.
 5. Vertical Alignment of Tie Bars and Dowels: 1/4 inch.
 6. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch.
 7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: Length of dowel 1/4 inch per 12 inches.
 8. Joint Spacing: Three inches (3").
 9. Contraction Joint Depth: Plus 1/4 inch, no minus.
 10. Joint Width: Plus 1/8 inch, no minus.

12. FIELD QUALITY CONTROL

- A. Testing Agency:
1. Engage a qualified independent testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement according to requirements specified in this Section.
 2. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.
- B. Testing Services: Testing shall be performed according to the following requirements:
1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to ASTM C172, except modified for slump to comply with ASTM C94.
 2. Slump: Per ASTM C143; one (1) test at point of placement for each compressive-strength test, but not less than one (1) test for each day's pour of each type of concrete. Additional tests will be required when concrete consistency changes.

3. Air Content: Per ASTM C231, pressure method; one (1) test for each compressive-strength test, but not less than one (1) test for each day's pour of each type of air-entrained concrete.
 4. Concrete Temperature: Per ASTM C1064; one (1) test hourly when air temperature is 40 deg F. and below and when 80 deg. F. and above, and one (1) test for each set of compressive-strength specimens.
 5. Compression Test Specimens: Per ASTM C31; one (1) set of four (4) standard cylinders for each compressive-strength test, unless otherwise indicated. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.
 6. Compressive-Strength Tests: Per ASTM C39; one (1) set for each day's pour of each concrete class exceeding five (5) cu. yd. but less than 25 cu. yd., plus one (1) set for each additional 50 cu. Yd. One (1) specimen shall be tested at seven (7) days and two (2) specimens at twenty-eight (28) days; one (1) specimen shall be retained in reserve for later testing, if required.
 - a. When frequency of testing will provide fewer than five (5) compressive-strength tests for a given class of concrete, testing shall be conducted from at least five (5) randomly selected batches or from each batch if fewer than five (5) are used.
 - b. When total quantity of a given class of concrete is less than 50 cu. yd., the Landscape Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.
 - c. When strength of field-cured cylinders is less than eighty-five-percent (85%) of companion laboratory-cured cylinders, current operations shall be evaluated and corrective procedures shall be provided for protecting and curing in-place concrete.
 - d. Strength level of concrete will be considered satisfactory if averages of sets of three (3) consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 PSI.
- C. Test results shall be reported in writing to the Owner, concrete manufacturer, and Contractor within 24-hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in site concrete, design compressive strength at 28-days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
- D. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by the Owner, but will not be used as the sole basis for approval or rejection.
- E. Additional Tests: Testing Agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by the Owner. Testing Agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed.
13. REPAIRS AND PROTECTION
- A. Remove in its entirety (from joint to joint) and replace site concrete that is broken, cracked, damaged, or defective, or concrete which does not meet requirements of this Section.
- B. Repair Standards: Repair of surface defects shall conform with applicable requirements of ACI 301. When using epoxy mortar, conform with requirements of ACI 503.4.
- C. Surface Defects:

1. Repair of surface defects shall begin immediately after form removal. For repair with epoxy mortar, concrete shall be dry.
 2. Surface defects are defined to include: form-tir holes, air pockets or voids, bug holes, honeycombed areas, rock pockets, visible construction joints, fins and burrs.
 3. Repair of surface defects shall be tightly bonded and shall result in concrete surfaces of uniform color and texture, matching adjacent like surfaces, and free of shrinkage cracks.
- D. Drill test cores where directed by the Landscape Architect, when necessary, to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory Site Concrete areas with Portland cement concrete bonded with epoxy adhesive.
- E. Protect Site Concrete from damage. Exclude traffic from Site Concrete for at least fourteen (14) days after placement. When construction traffic is permitted, maintain Site Concrete as clean as possible by removing surface stains and spillage of materials as they occur.
- F. Maintain exposed Site Concrete free of stains, discoloration, dirt, and other foreign material. Clean Site Concrete not more than two (2) days before date scheduled for Substantial Completion inspection.

14. CAST-IN-PLACE SITE CONCRETE SCHEDULE

Site Concrete Type (as noted in Contract Drawings)	Portland Cement Type	Maximum Aggregate Size	Integral Color Admixture	Min. Compressive Strength at 28 days (in PSI)	Maximum Water/Cementitious Materials (W/CM) Ratio (in %)	Maximum Slump Limit (in inches)	Air Entrainment	Finish (including Sealer Type)
Type-1	Type I	¾"	Davis Color, TBD by LA	3,000	.50	4"	5%-7 %	TBD by LA
Type-2	Type I	¾"	Davis Color, TBD by LA	3,000	.50	4"	5%-7 %	TBD by LA

END OF SECTION

Section 32 13 73 – Concrete Joint Sealants

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Hot-applied joint sealants.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers eight samples of materials that will contact or affect joint sealants. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

1.3 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Pavement-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.
- D. Product certificates.
- E. Product test reports.
- F. Preconstruction compatibility and adhesion test reports.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021.
- B. Preinstallation Conference: Conduct conference at the project site.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide joint sealants, backing 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.
- B. Colors of Exposed Joint Sealants: As indicated by manufacturer's designations.

2.2 COLD-APPLIED JOINT SEALANTS

- A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafco Inc., an ERGON company; RoadSaver Silicone.
 - b. Dow Corning Corporation; 888.
 - c. Pecora Corporation; 301 NS.
- B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.
 - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
 - b. Dow Corning Corporation; 890-SL.
 - c. Pecora Corporation; 300 SL.
- C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Pecora Corporation; Urexpam NR-200.

2.3 HOT-APPLIED JOINT SEALANTS

- A. Hot-Applied, Single-Component Joint Sealant for Concrete: ASTM D 3406.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Crafco Inc., an ERGON company; Superseal 444/777.

- B. Hot-Applied, Single-Component Joint Sealant for Concrete and Asphalt: ASTM D 6690, Types I, II, and III.
 - 1. Products: Subject to compliance with requirements, provide the following:
 - a. Meadows, W. R., Inc.; Sealtight Hi-Spec or Sealtight 3405
 - b. Right Pointe; D-3405 Hot Applied Sealant.

2.4 JOINT-SEALANT BACKER MATERIALS

- A. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D 5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.
- B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.
- C. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D 5249; 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.

2.5 PRIMERS

- A. Primers: Product 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.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Cleaning of Joints: Clean out joints immediately before installing joint sealants.
- C. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- D. Install joint-sealant backings of kind indicated 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 backings.
 - 2. Do not stretch, twist, puncture, or tear joint-sealant backings.

3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.
- E. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place joint 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 Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to 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.
- G. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.
- H. Clean off excess joint 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.

END OF SECTION

SECTION 321400 – UNIT PAVING

1.GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required, to make a complete, universally-accessible Unit Paving installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Stone Unit Paving Modules.
 - 2. Compaction of Soil Sub-Grade.
 - 3. Graded Compacted Aggregate Sub-Base Material.
 - 4. Sand Bedding Material (Sand for Leveling/Bedding Course).
 - 5. Mortar Setting Material (for Unit Paver edges adjoining planting areas).
 - 6. Joint Filler Material (Polymer-Modified (Polymeric) Finishing Sand for Paving Joints).
 - 7. Accessories (Geotextile Filter Fabric, Soil Sterilant, etc.).
 - 8. Unit Paving Sealant.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 312219 – Landscape Grading.
 - 2. Section 321313 – Concrete Paving, for Cast-in-Place Concrete Edge Restraints.
 - 3. 04 42 01 – Dimension Stone Cladding

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ADAAG – American with Disabilities Act Accessibility Guidelines.
 - 2. ANSI – American National Standards Institute.
 - 3. ASTM – American Society for Testing and Materials.
 - 4. BSI – Building Stone Institute.
 - 5. CBC – California Building Code, Title 24 Disabled Access Regulations.
 - 6. NBGQA - National Building Granite Quarries Association.
 - 7. NSTC – National Slate Technology Center.
- B. Material Specification Standards:
 - 1. ANSI A118.4 – Standard Specification for Latex-Portland Cement Mortar.
 - 2. ASTM C33 – Standard Specification for Concrete Aggregates.
 - 3. ASTM C144 – Standard Specification for Aggregate for Masonry Mortar.
 - 4. ASTM C270 – Standard Specification for Mortar for Unit Masonry.
 - 5. ASTM C615 – Standard Specification for Granite Dimension Stone.
 - 6. ASTM C629 – Standard Specification for Slate Dimension Stone.
- C. Material Testing Standards:
 - 1. ASTM C97 – Standard Test Method for Absorption and Bulk Specific Gravity of Dimension Stone.
 - 2. ASTM C99 – Standard Test Method for Modulus of Rupture of Dimension Stone.

3. ASTM C120 – Standard Test Method of Flexure Testing of Slate (Modulus of Rupture, Modulus of Elasticity).
4. ASTM C121 – Standard Test Method for Water Absorption of Slate.
5. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
6. ASTM C140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
7. ASTM C170 – Standard Test Method for Compressive Strength of Dimension Stone.
8. ASTM C199 – Standard Test Method for Pier Test for Refractory Mortars.
9. ASTM C217 – Standard Test Method for Weather Resistance of Slate.
10. ASTM C241 – Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic.
11. ASTM C780 – Standard Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
12. ASTM C880 – Standard Test Method for Flexural Strength of Dimension Stone.
13. ASTM D448 – Standard Classification for Sizes of Aggregate for Road and Bridge Construction.
14. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
15. ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.

D. Measurements:

1. PSI: Measurement, in pounds per square foot.
2. CU/FT: Measurement, in cubic-foot.
3. Percent Compaction: Per ASTM D1557, percentage of the maximum in-place dry density of the same material, as determined by the Geotechnical Engineer.

3. SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Product/Material Data: Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
 - a. Stone Unit Pavers.
 - b. Graded Aggregate Sub-Base Material.
 - c. Sand for Levelling/Bedding.
 - d. Mortar Setting Material.
 - e. Joint Filler Material.
 - f. Accessories (Geotextile Filter Fabric, Soil Sterilant).
 - g. Finished Surface Sealer.

2. Submit Manufacturer Qualifications.
 3. Material Test Reports: Submit test results from an independent testing laboratory for compliance of each type of material specified, per associated ASTM standards. Cost of testing shall be borne by the Contractor.
 - a. Unit Paving Modules:
 - 1) Test Units for compressive strength, water absorption, and dimensional tolerance per ASTM C140.
 - 2) A minimum of five (5) full size Units per test are required for an average value.
 - b. Graded Aggregate Sub-base Material: Sieve analysis per ASTM D448, meeting ASTM D2940 gradation.
 - c. Sand Bedding Material (Sand for Leveling/Bedding Course): Sieve analysis per ASTM C136, meeting modified ASTM C33 gradation.
 - d. Joint Filler Material (Polymer-Modified (Polymeric) Joint Sand): Sieve analysis per ASTM C136, meeting modified ASTM C144 gradation.
 4. Maintenance Program: Submit Manufacturer-recommended program for maintenance of each type of Unit Paving indicated herein.
 5. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar installations.
 6. Scaled Shop Drawings: Not Required.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
1. In full-size Units, submit Sample sets of each type of Unit Paving indicated herein this Section. Provide Sample sets of each size and shape for each color, texture, and pattern specified, showing the full range of variations expected in these characteristics.
 2. One (1) pound sample of Graded Aggregate Sub-base material. Submit in re-sealable plastic bag, and label accordingly.
 3. 12" x 12" square panel of Geotextile Filter Fabric.
 4. One (1) pound sample of Sand for Leveling/Bedding. Submit in re-sealable plastic bag, and label accordingly.
 5. One (1) pound sample of Joint Filler Material (Polymer-Modified (Polymeric) Joint Sand). Submit in re-sealable plastic bag, and label accordingly.
- D. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- E. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.
4. QUALITY ASSURANCE AND CONTROL
- A. Manufacturer Qualifications: Each Manufacturer shall specialize in the manufacturing of Unit Paving Materials for a minimum of five (5) years.
1. Acceptable Manufacturer shall be a standing member of the ICPI.

- B. Installer Qualifications:
1. Requirement: Valid California C-61 (Limited Specialty D-06 "Concrete-Related Services") License.
 2. Engage an experienced Installer who has completed Unit Paving installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance. Installation shall be by a Contractor and crew with at least two (2) years of experience in placing Unit Paving on projects of similar nature and dollar cost.
- C. Single-Source Responsibility: Obtain each color, type, and variety of Unit Paving type, joint materials, and setting materials from a single source with resources to provide products and materials of consistent quality in appearance and physical properties without delaying the Work.
- D. Pre-installation Conference:
1. Before installing Work as indicated herein this Section, conduct a Pre-installation Conference at the Project Site with the Landscape Architect to review requirements and design objectives, including a review of textures, colors, finishes, layouts, and other design intents of the Work. Conference shall be held prior to erecting the Field-Constructed Mock-up Samples.
 2. Notify participants in writing at least five (5) working days prior to Conference.
- E. Manufacturer's Directions: Follow Manufacturer's directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings and Contract Specifications.
- F. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
- G. Field-Constructed Mock-ups:
1. Provide complete Field-Constructed Mock-ups for all respective materials receiving finishing which is to be used as the basis for judging quality of workmanship throughout the project, as follows:
 - a. Size: Provide one (1) Field-Constructed Mock-up for each Unit Paving type indicated herein this Section. Each Mock-up shall measure 4'-0" wide x 6'-0" long, and include the edge restraint material at the perimeter of the Mock-up as indicated per the Contract Drawings.
 2. Prior to the installation of Work in this Section, erect Field-Constructed Mock-ups to verify selections made under the Submittals Article herein to demonstrate aesthetic effects as well as qualities of materials and execution. Build Field-Constructed Mock-ups to comply with the following requirements, using materials indicated for final Unit of Work, including same base construction, joints, and contiguous Work as indicated.
 3. Locate Field-Constructed Mock-ups in the location and of the size indicated or, if not indicated, as directed by the Owner.
 4. Notify the Landscape Architect at least one (1) week in advance of the dates and times when the Field-Constructed Mock-ups will be erected and ready for review.
 5. Demonstrate the proposed range of aesthetic effects and workmanship in the Field-Constructed Mock-ups that will be produced in final Unit of Work.
 6. When the Landscape Architect determines that Field-Constructed Mock-ups does not meet requirements, retain it for reference and construct additional Field-Constructed Mock-ups until it is accepted. Modify or correct Work as directed by Landscape Architect.
 7. Obtain the Landscape Architect's acceptance of the Field-Constructed Mock-ups, in writing, prior to the start of the final Unit of Work. Accepted Mock-ups is a prerequisite to commencing Work under this Section.

8. Retain and maintain Field-Constructed Mock-ups during construction in an undisturbed condition. Accepted Field-Constructed Mock-ups shall be the standard for judging the completed Work under this Section.
9. Demolish and remove the Field-Constructed Mock-ups when directed by the Owner.
10. Accepted Field-Constructed Mock-ups may become part of the completed Work, if directed by the Landscape Architect.

5. DELIVERY, STORAGE, AND HANDLING

- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft or damage. It is the responsibility of the Contractor to install "factory condition" Units.
- B. Deliver packaged materials in original, unopened, undamaged, and dry packaging, with manufacturer's labels intact. Products must be stored in a dry area and not exposed to any moisture.
- C. Deliver materials in a timely manner so as to not delay Work, and install only after preparations for installation have been completed.
- D. Protect Unit Pavers and other materials during storage and construction against soilage or contamination from earth and other materials.
 1. Wrap pavers in plastic or use other packaging materials that will prevent rust marks from steel strapping used in shipping.
 2. Deliver and unload materials at the Project Site in such a manner that no damage occurs to the products or materials.

6. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. General: Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- C. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- D. Excavation: When conditions detrimental to installing Unit Paving is encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease installation operations and notify Landscape Architect for further direction.
- E. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic as required for other construction activities during installation of Unit Paving. Access shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
- F. Grades and Levels: Establish and maintain required levels and grade elevations. Review installation procedures and coordinate Work herein this Section with other Work affected.

- G. Weather: Perform installation of Unit Paving only when weather and soil conditions are suitable in accordance with locally accepted practices. Do not install Unit Pavers during rain or while sub base is wet from rain. Do not apply Soil Sterilant when winds exceed ten (10) mph or during or immediately after rain.
 - 1. Hot-Weather Requirements: Protect Unit Paving Work in hot weather by providing artificial shade, wind breaks and use cooled materials, as required.
- H. Sequence and Scheduling:
 - 1. Do not install Work under this Section prior to acceptance of sub-grade preparation Work under another Section.
 - 2. Install edging/header materials prior to placement of Unit Paving.
 - 3. Coordinate with other trades to insure proper placement of irrigation sleeves (per Section 328400) prior to installation of Unit Paving.
- I. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. EXTRA MATERIALS

- A. Provide additional Unit Paver materials to the Owner to be used for future repairs. Deliver surplus Unit Pavers and Joint Filler Materials on separate pallets, consistent with the requirements of the Delivery, Storage and Handling Article.
 - 1. Quantities:
 - a. Unit Pavers: Provide a minimum of one-percent (1%) of the total quantity installed of each Unit Paving in each respective Unit size/color as indicated herein this Section.
 - b. Pre-packaged Joint Filler Material: Provide One (1) surplus bag equal to the type, color, and manufacturer as installed, per each 500 SF of installed Unit Paving.

8. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.

- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. STONE UNIT PAVING MODULES

- A. General: Provide materials and products that result in consistent colors, textures, and patterns of the Stone Unit Paving surfaces. Install in necessary quantity in areas as indicated on the Contract Drawings.
- B. Type: Solid Stone Unit Paving Modules, manufactured per in size, shape, color, texture, and other requirements, as indicated:
1. Reference Standards:
 - a. Meet ASTM C615 - Specification for Granite Dimension Stone.
 - b. Meet ASTM C616 - Specification for Basalt Dimension Stone.
 2. Testing and Physical Properties: Sample test Units prior to delivery. A minimum of five (5) specimens per test are required for an average value. Compile tests using full size Units, meeting the following:
 - a. Bulk Density: Tested per ASTM C97 - Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone, with a Minimum Density of 160 lbs./cu.ft.
 - b. Water Absorption: Tested per ASTM C97 - Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone, with a maximum percentage of Water Absorption at 1.0%.
 - c. Abrasion Resistance: Tested per ASTM C241 - Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic, with a Minimum Abrasion Resistance value of 8. Finished Stone Unit Paving surfaces under this Article shall be "slip-resistant", per the requirements outlined in the California Building Code, Section 1124B.1 and ADAAG 4.5.1.
 - d. Modules of Rupture: Tested per ASTM C99 - Test Methods for Modulus of Rupture of Dimension Stone. Modules of Rupture shall meet or exceed XXXX PSI
 - e. Compressive Strength: Tested per ASTM C170 - Test Method for Compressive Strength of Dimension Stone. Average Compressive Strength shall meet or exceed 20,000 PSI
 3. Dimensional sizes: (as expressed in the ratio of length x width):
 - a. Refer to Contract Documents
 4. Thickness: Minimum 2" thick for pedestrian traffic.
 5. Dimensional Tolerances:
 - a. Length or width: Units shall not differ by more than 1/16" from approved samples.
 - b. Height/Thickness: Units shall not differ by more than 1/8" from the specified standard dimensions.
 - c. Provide sound Stone Unit Paving free of defects that would interfere with proper placing of the Units or impair strength or permanence of construction. Minor cracks and minor chipping incidental to methods of manufacture, handling in shipment, and delivery will be acceptable subject to the Landscape Architect's review and acceptance. Excessive cracks and chipping, as determined by the Landscape Architect will be rejected as not complying with the specification requirements.
 - d. Rejection: In the event the Units fail to conform to the specified testing requirements, the Manufacturer may sort it, and new test Units shall be selected at random by the Landscape Architect from the retained lot and tested at the expense of the

Manufacturer. If the second test of test Units fails to conform to the specified requirements, the entire lot shall be rejected.

6. Stone Type and Color:
 - A. Granite Wall Paving (M-10): Black Granite Stone with textured finish. Stone to be produced per the contract documents. Stainless Steel inlay to be incorporated into the paver. Stone color(s) and finishes as selected and approved by the Architect.
 1. Cold Spring: Raven Noir, Cold Springs Black, Academy Black with textured finish.
 2. Quarra Stone: Volga Black Bright Blast Finish - black granite to have small grain size and uniform black color appearance with light color variation. Min. density of 185 lbs/ft³. Min Compressive Strength of 32,000 Psi.
 3. Or Equivalent to be approved by the Architect.
 - B. Timeline Paving (M-9): Black Granite Stone with textured finish. Stone to be produced per the contract documents. Stainless Steel inlay to be incorporated into the paver. Stone color(s) and finishes as selected and approved by the Architect.
 4. Cold Spring: Mesabi Black with rub and sand finish.
 5. Quarra Stone: Quarra Black Bright Finish - black granite with small to medium grain size and uniform black coloration. Min. density of 175 lbs / Ft³. Min Compressive Strength of 20,000 Psi.
 6. Or Equivalent to be approved by the Architect.
 - C. Basalt Paving (M-8): Grey Basalt Pavers, 2" thick for pedestrian traffic only with sand set joints over crushed aggregate per the contract documents. Stone color and finishes as selected and approved by the Architect.
 7. Quarra Stone: Quarra Basalt Spoken Finish- black basalt stone with very little to no grain variation. Min. density of 180 lbs/ Ft³. Min Compressive Strength of 27,000 PSI
 8. Or Equivalent to be approved by the Architect.
 - D. Basalt Paving (M-8): Grey Basalt Pavers, 2" thick for pedestrian traffic only with sand set joints over crushed aggregate per the contract documents. Stone color and finishes as selected and approved by the Architect.
 9. Quarra Stone: Quarra Basalt Spoken Finish- black basalt stone with very little to no grain variation. Min. density of 180 lbs/ Ft³. Min Compressive Strength of 27,000 PSI
 10. Or Equivalent to be approved by the Architect

7. Finishes: Unless otherwise indicated, provide the following finishes in accordance with the NBGQA:
 - a. Unless otherwise indicated, exposed surfaces shall have a thermal finish to match the referee sample; all other surfaces shall be sawn.
 - b. Unless otherwise indicated, exposed surfaces shall have a honed finish to match the referee sample; all other surfaces shall be sawn.
 - c. Unless otherwise indicated, exposed surfaces shall have a shot-ground finish to match the referee sample; all other surfaces shall be sawn.
 - d. Unless otherwise indicated, exposed surfaces shall have a bush-hammered finish to match the referee sample; all other surfaces shall be sawn.
 - e. Unless otherwise indicated, exposed surfaces shall have a sandblasted finish to match the referee sample; all other surfaces shall be sawn.
8. Pattern(s): Pattern(s) of finished surface shall be in accordance to the layout as indicated in the Contract Drawings. Butt joint and maintain continuity of alignment that minimizes the need to sawcut the Stone Unit Paving to satisfactorily fit to the designated pattern(s) within the designated area.
9. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Cold Springs Granite Company, MN. Contact LeAnne Black- email: lblack@coldspringusa.com, tel: 480.330.6972
 - b. Quarra Stone Company. Sun Prairie, WI. Contact Steven Rousseau- email: Steven@quarrastone.com, tel 540.522.9263
 - c. Or Equivalent to be approved by the Architect.

2. GRADED AGGREGATE SUB-BASE MATERIAL

- A. Graded Aggregate Sub-base: Quality-controlled, graded aggregate.
 1. Conform to the grading requirements of ASTM D2940.
 2. Sieve accordingly per ASTM D448.

3. SAND BEDDING MATERIALS

- A. Sand for Leveling/Bedding Course:
 1. General: Sand for Leveling/Bedding Course shall be clean, washed, fine-textured, sharp (angular), neutral pH, no salinity, free from deleterious or foreign matter.
 2. Conform to ASTM Requirements for Concrete Sand. Sieve accordingly per ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 3. Properties and Gradation: Conform to the grading requirements of ASTM C33 with modifications as follows:

Grading Requirements for Sand for Leveling/Bedding Course ASTM C33 Sieve Analysis	
Sieve Size	Percent (%) Passing
3/8"	100
No. 4	95-100
No. 8	85-100

No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	2-10
No. 200	0-1

4. Sand Bedding Material conforming to ASTM C144 (Mason's Sand) shall not be used.

6. MORTAR SETTING MATERIALS

A. Mortar Mix (pre-blended, pre-packaged factory Mix):

1. Meet ASTM C270 and comply with CBC Standards 21-15, for Type S Mortar.
 - a. Comply with referenced standards and with manufacturers' written instructions for mix proportions, mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures needed to produce Mortar of uniform quality and with optimum performance characteristics.
2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Mac High Absorbent Brick Mortar Polymer Modified (H.A.B. Poly) Type S*, Orco Blended Products, Inc.
 - b. *Spec Mix® Pre-Blended Dry Mortar Type S*, Premix Products of Southern California.
 - c. Or equal, as approved by the Landscape Architect.

7. JOINT FILLER MATERIALS

A. Polymer-Modified (Polymeric) Finishing Sand for Paving Joints:

1. General: Polymer-Modified (Polymeric) Finishing Sand for Paving Joints shall meet or exceed ASTM C-144 grading; it shall be a polyymmer-modified, high-performance, pre-packaged product, clean, washed, fine-textured, sharp (angular), neutral pH, no salinity or deleterious materials (to avoid staining or efflorescence), resistant to insect and inhibits weed growth, with formulated bonding polymers.
2. Properties and Gradation: Conform to the grading requirements of ASTM C144 with modifications as follows:

Grading Requirements for Finishing Sand for Paving Joints ASTM C144 Sieve Analysis	
Sieve Size	Percent (%) Passing
No. 4	100
No. 8	95-100
No. 16	70-100
No. 30	40-100
No. 50	20-40

No. 100	10-25
No. 200	0-10

3. Sieve accordingly per ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. Color:
 - a. Dark Gray/Black. Final color selection of Joint Sand to be confirmed upon final color selection of Unit Paver Modules during Submittals.
5. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Polysweep*, SEK/Surebond, Inc.
 - b. *HP2 Polymeric Sand for Pavement Joints*, Techni-Seal.
 - c. *Joint-Lock™ Sand*, Package Pavement.
 - d. *PowerLoc™ Jointing Sand*, Quikrete Products,
 - e. *Bonsal® Polymeric Joint Sand*, Bonsal American.
 - f. Or equal, as approved by the Landscape Architect.

8. ACCESSORIES

- A. Geotextile Filter Fabric: Permeable, lightweight, continuous, non-woven, geo-textile polypropylene filament material, UV resistant, engineered to allow water permeability and deter soil permittivity per ASTM D4491. Geotextile Filter Fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis and acids. Meet AASHTO M288-96, Class 1. Fabric shall have a permeability rating 10 times greater than that of soil on which paving is founded and an AOS (apparent opening size) small enough to prevent passage of fines from leveling course into graded aggregate of base course below.
 1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Amoco 4553*, Amoco Fabrics and Fibers Company.
 - b. *FX-80HS*, Carthage Mills.
 - c. *C-80NW*, Contech.
 - d. *180 EX*, Linq.
 - e. *Geotex 801*, Propex. Inc.
 - f. *TerraTex N08*, Webtec.
 - g. *180N*, TC Mirafi.
 - h. Or equal, as approved by the Landscape Architect.
- B. Soil Sterilant: Non-Selective Post-Emergent Herbicide: Spray-applied solution containing a minimum of 41% of the active ingredient "glyphosate" (full strength), with a surfactant, mixed with water accordingly per the Manufacturer's directions.
 1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Roundup® PRO*, (41% glyphosate), Monsanto Company, St. Louis, MO.
 - b. *Roundup® PRO Concentrate (50% glyphosate)*, Monsanto Company, St. Louis, MO.
 - c. *Honcho® Plus*, (41% glyphosate), Monsanto Company, St. Louis, MO.
 - d. *High Yield® Kill-Zall Weed & Grass Killer*, (41% glyphosate), Voluntary Purchasing Groups, Boneham, TX.
 - e. Or equal, as approved by the Landscape Architect.
- C. Water: Per ASTM C1602, from potable water source, free from deleterious materials such as oils, acids, and organic matter.

9. UNIT PAVING SEALANT

- A. Penetrating Sealant: To be reviewed with the Stone Supplier.
1. General: Penetrating Sealant shall be an invisible, water-based Penetrating Sealant, used to protect exterior Unit Paving installations. Sealant shall be a clear, non-flammable, UV-stabilized, non-yellowing solution which cures to reduce staining, soiling, discoloration, efflorescence, and acts as a invisible water-repellant coating, formulated to impart water repellence and dirt reduction to Unit Paving surfaces with no change in the surface appearance. Sealant shall react with carbon dioxide, and atmospheric moisture to form a penetrating water, dirt and mildew repellent barrier within 24 hours. Moisture absorption rate shall be low to reduce visible surface changes for up to ten (10) years.
 2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Natural Look Penetrating Sealer*, Glaze 'N Seal.
 - b. *Sinak Sealer S-101*, Sinak Corporation.
 - c. *Standoff SLX100 Water & Oil Repellant*, Prosoco, Inc.
 - d. *Thoroclear® Water-Based Sealer*, Thoro/ChemRex, Inc.
 - e. *HydraSeal*, Endur-O-Seal.
 - f. *Cementone*, L.M. Scofield Company.
 - g. *Sealhard*, L&M Construction Chemicals.
 - h. *White Mountain Ultrapel™*, Triangle Coatings, Inc.
 - i. Or equal, as approved by the Landscape Architect.
- B. Multi-Purpose Water-Based (Film-forming) Sealant:
1. General: Multi-Purpose Water-Based (Film-forming) Sealant shall be a clear, acrylic, non-flammable, non-yellowing, UV-stabilized, water-based Sealant, designed to protect and beautify exterior Unit Paving finishes. Applied by spray or brush in light, even coats, Sealant shall penetrate the surface to give a semi-gloss finish. Sealer shall protect Unit Paving surfaces against organic stains, including oil, grease, and beverages.
 2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Multi-Purpose Water-Based Sealer*, Glaze 'N Seal.
 - b. *Atlas Outshine Sealer*, Atlas Tech Products.
 - c. *Sinak HLQ-125*, Sinak Corporation.
 - d. *Deep Sheen WB*, Prosoco, Inc.
 - e. *Thoroglaze®*, Thoro/ChemRex, Inc.
 - f. *Cureseal (Semi-Gloss)*, L.M. Scofield Company.
 - g. *Safe Cure & Seal™ 30%*, Dayton Superior Chemical & Cement Products.
 - h. Or equal, as approved by the Landscape Architect.
- C. Multi-Purpose Solvent-Based (Film-forming) Sealant:
1. General: Multi-Purpose Solvent-Based (Film-forming) Sealant shall be a clear, acrylic, non-yellowing, UV-stabilized, low VOC solvent-based lacquer sealant designed to protect and beautify exterior Unit Paving finishes. Applied by spray or brush in light, even coats, Sealant shall penetrate the surface to give a “wet-look” gloss finish. Sealant shall protect Unit Paving surfaces against organic stains, including oil, grease, and beverages.
 2. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Wet Look 2000 Lacquer*, Glaze 'N Seal.
 - b. *Atlas Cure & Seal 30%*, Atlas Tech Products.
 - c. *Paver Enhancer*, Prosoco, Inc.
 - d. *Thoroshield®*, Thoro/ChemRex, Inc.
 - e. *Expo-Gloss*, Sealtight/WR Meadows, Inc.
 - f. Or equal, as approved by he Landscape Architect.

3.EXECUTION

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 of Unit Paving. Do not proceed with installation until unsatisfactory conditions have been corrected.

2. FABRICATION

- A. Fabricate Dimensional Stone in accordance with the tolerances specified in NBGQA Specifications and as indicated.
 - 1. Dimensional Stone faces shall be at right angles to the plane of the top.
 - 2. Granite shall be cut accurately to required shapes and dimensions.
 - 3. Holes, cut-outs, sinkages and openings in granite work for anchors, cramps, dowels, supports, and lifting devices shall be accurately cut or drilled to required dimensions, as shown on the approved Shop Drawings, and as necessary to secure granite in place to ensure correct location and accurate fit of all fixtures. Setting beds shall be shaped to fit supports.
 - 4. Arrises shall be cut sharp and true to square, and continuous with adjoining arrises. Where exposed, arrises shall be erased.
- B. Flatness Tolerance: Variation from true plane, or flat surfaces, shall be determined by use of a four-foot (4') long straightedge, applied in any direction on the surface. Such variations on polished, honed and fine rubbed surfaces at the bed and joint arris lines shall not exceed 3/64" or 1/16 of the specified joint, whichever is greater. On surfaces having other finishes, the maximum variation from true plane at the bed and joint arris lines shall not exceed 1/4 of the specified joint width.
- C. Variations from true plane on other parts of the face surfaces shall not exceed the following:
 - 1. Polished, honed or fine rubbed finishes: 3/64 in.
 - 2. Rubbed or fine stippled sandblasted finishes: 1/16 in.
 - 3. Shot ground, 8- and 6-cut finishes: 1/8 in.
 - 4. Thermal and coarse stippled sandblasted finishes: 3/16 in.
- D. Backs of pieces shall be sawn or roughly dressed to approximate true planes. Maximum variation in thickness from the specified shall not exceed the following:
 - 1. 1/4 in. on pieces up to modular 12 in. thick.
 - 2. 1/2 in. on pieces above 12 in. modular thick.

3. PREPARATION OF UNIT PAVING EDGE RESTRAINTS

- A. Provide Cast-in-Place Concrete Edge Restraints as indicated on the Contract Drawings, under requirements of another Section. Install Edge Restraints prior to placing Graded Aggregate Sub-Base.

4. PREPARATION OF COMPACTED SOIL SUB-GRADE

- A. Proof-roll prepared Compacted Soil Sub-Grade surface to check for unstable areas, areas requiring additional Compacted Soil Sub-Grade, unstable areas, and areas requiring compaction to meet the following:
 - 1. Pedestrian Areas: Compact Soil Sub-Grade uniformly to at least ninety-five-percent (95%) Standard Proctor Density, per ASTM D698.
 - 2. Vehicular Use Areas: Compact Soil Sub-Grade uniformly to at least ninety-five-percent (95%) Modified Proctor Density, per ASTM D1557.
 - B. Verify that sub-grade preparation, compacted density, and elevations conform to specified requirements.
 - C. Provide written density test results for soil Sub-grade to the Owner. Do not proceed with Work until deficient Compacted Soil Sub-grades have been corrected and accepted.
5. PREPARATION OF GRADED COMPACTED AGGREGATE SUB-BASE
- A. Verification: Verify location, type, and elevations of edge restraints, concrete collars around utility structures, and drainage inlets.
 - B. After Acceptance of Compacted Soil Sub-Grade, place Graded Compacted Aggregate Sub-Base at required depth as indicated on the Contract Drawings. Set Graded Compacted Aggregate Sub-Base in equal compacted layers, with each layer not exceeding four-inches (4") in thickness. Thickness of the layers shall also be consistent with the capabilities of the compaction equipment. Meet the following compaction densities:
 - 1. Pedestrian Areas: Compact Graded Aggregate Sub-base uniformly to minimum ninety-five-percent (95%) Proctor Density, in accordance with ASTM D698.
 - 2. Vehicular Use Areas: Compact Graded Aggregate Sub-base uniformly to at least ninety-five-percent (95%) Modified Proctor Density, per ASTM D1557.
 - C. Tolerances: It is essential that the intended surface profile is formed by the Graded Compacted Aggregate Sub-base so the Unit Paving Modules can be placed on a uniform thickness of Bedding Sand. Meet the following:
 - 1. Graded Compacted Sub-Base surface tolerance should be +/- 3/8" over a 10'-0" straight edge.
 - D. Verify that Graded Compacted Aggregate Sub-Base materials, thickness, compactness density, surface tolerances, and elevations conform to specified requirements.
 - E. Provide written density test results for Graded Compacted Aggregate Sub-Base to the Owner. Do not proceed with Work until deficient Sub-base has been corrected and accepted.
6. INSTALLATION OF GEOTEXTILE FILTER FABRIC
- A. Verification:
 - 1. Verify Compacted Sub-Base is dry and accepted as meeting material, installation, and grade requirements
 - 2. Verify Installation of Edge Restraints/Headers in locations as indicated on the Contract Drawings at the indicated elevations.
 - B. Geotextile Filter Fabric: Set Geotextile Filter Fabric onto the surface of the accepted Compacted Sub-Base. Smooth out the Geotextile Filter Fabric, lapping the edges a minimum of 1'-0". Geotextile Filter Fabric shall be placed so that the material entirely covers the Compacted Sub-

Base and extends up the side of the areas that contain the Setting Bed material. Do not allow construction equipment on the Geotextile Filter Fabric.

7. INSTALLATION OF LEVELING/BEDDING COURSE

- A. Spread Sand for Leveling/Bedding Course evenly over the Geotextile Filter Fabric and screed rails, using the rails and/or edge restraints to produce a uniform nominal thickness of one-inch (1"). The moisture content shall remain constant and the density is loose and constant until Unit Paving Modules are set and compacted.
 - 1. The Leveling/Bedding Course is not meant to and shall not be used to fill in low spots nor its thickness adjusted to bring the paving to the correct grade. Any changes in thickness or undulations in the Leveling/Bedding Course will reflect on the paving surface, and shall be subject to rejection by the Landscape Architect.
 - 2. Do not disturb screeded surface.
 - 3. Screeded areas shall not substantially exceed that which is covered by Unit Paving Modules in one (1) day's work.
 - 4. Do not use Sand for Leveling/Bedding Course to fill depressions in the base surface.
- B. Application of Soil Sterilant:
 - 1. Mixing: Mix Soil Sterilant product in sprayer tank with clean water, according to Manufacturer's current printed instructions. Use sprayer, which will apply the solution uniformly, without disturbing the soil.
 - 2. Spray Solution: Shake or stir prior to each application. Apply to dry surface only.
 - 3. Over-spraying: Avoid spraying on walls, adjoining pavements, and areas to receive planting.
 - 4. Depth: Apply to finished surface of Leveling/Bedding Course.

8. INSTALLATION OF UNIT PAVERS

- A. Do not use Unit Paving Modules with chips, cracks, spalled edges, voids, discolorations, and other defects that might be visible or cause staining in finished Work. Remove and replace defective or broken Units at the direction of the Landscape Architect. Units shall be clean and free of dirt and foreign matter on all sides, and shall be dry before setting.
- B. Mix Unit Paving Modules obtained from several different pallets or cubes as they are placed to produce uniform blend of colors and textures.
- C. Place Unit Paving in the desired pattern(s) as indicated in the Contract Drawings, laid with a 1/16" to 1/8" average joint width, being careful not to disturb Leveling/Bedding Course.
 - 1. If Unit Paving has integral-cast spacer bars, place Units hand tight against spacer bars. Fill gaps between Units that exceed 3/8-inch with pieces cut to fit from full-size Unit Pavers.
 - 2. Joint width shall not exceed 3/16".
- D. String lines or chalk lines to maintain the aligned pattern(s). Units shall be set true to the required lines and grades. Joints shall be uniform in thickness. Set whole Units first, followed by Units that are cut to size. Cut Units, when necessary, with motor-driven masonry saw equipment to provide an accurate, clean, straight, sharp cut, with un-chipped or spalled edges. Cut Units to provide pattern indicated and to fit adjoining work neatly. Use full Units without cutting, where possible.
 - 1. Hammer cutting is not acceptable.
 - 2. For Precast Concrete Unit Paving Modules, a block splitter may be used.

- E. Joint Pattern(s): Patterns as indicated on the Contract Drawings.
 - F. Tolerances: See Unit Paving Tolerances Article indicated herein this Section.
 - G. Where Unit Paving Modules meet the sides of edge restraints, or where special patterns are delineated in the overall layout plan, the Unit Paving Modules that meet the edges of these conditions shall be of whole units to the greatest extent possible. Units that are required to be cut or split to complete the layout composition shall not be smaller than $\frac{3}{4}$ the size of the smallest module unit. Contractor shall be responsible to field-adjust the pattern of the Unit Paving Modules accordingly, per the direction of the Landscape Architect.
 - H. Keep heavy equipment off newly laid Unit Paving Modules that have not received initial compaction and sanded joints.
 - I. Once set, vibrate Unit Paving Modules into Leveling/Bedding Course with a low-amplitude plate vibrator capable of at least 5000-lbf compaction force at a frequency of 75 to 100 Hhz to vibrate the Unit Paving Modules into the Leveling/Bedding Course. Perform at least three (3) passes across the surface with the plate vibrator. Remove any cracked or damaged Unit Paving Modules and replace with new Units. Vibrate under the following conditions:
 - 1. After edge pavers are installed and there is a completed surface or before surface is exposed to rain.
 - 2. Before ending each day's Work, fully compact installed Unit Paving within thirty-six-inches (36") of the laying face. Cover the open layers with non-staining plastic sheets overlapped 48-inches on each side of the laying face to protect from rain.
9. MORTAR BEDDING
- A. Place Mortar in accordance with ACI 530.1, in locations where required as indicated per Contract Drawings.
 - B. Mortar-set Unit Paving modules shall be set flush and aligned with adjoining sand-set Unit Paving modules so there is no visible difference in the finished surfaces between either methods of installation. Remove and re-lay in fresh Mortar any Unit Paving module that has been disturbed to the extent the initial Mortar bond is broken.
10. APPLICATION OF SANDED JOINTS
- A. General:
 - 1. Follow manufacturer's directions for installation.
 - B. Preparation:
 - 1. Temperature must be above 32d F for 48-hours following installation.
 - 2. Surface and joints must be completely dry, and joints free of dirt and debris. Any moisture that is evident on the surface will commence a premature bonding reaction of the polymers in the Joint Sand material.
 - 3. Do not install if rain is forecasted.
 - C. Placement of Pre-Packaged Polymer-Modified (Polymeric) Joint Sand:
 - 1. Spread Pre-Packaged Polymer-Modified (Polymeric) Joint Sand material over paved surfaces evenly and into joints between Unit Paving immediately after vibrating Unit Paving Modules into Leveling/Bedding course. Completely cover Unit Paving surface with thin

- layer of Joint Sand material, using push broom. Sweep the material into the joints with a slight pounding motion.
2. Once a substantial area of the surface has been swept, vibrate the Unit Paving surface with the plate vibrator/compactor in overlapping passes.
 3. Continue procedure, spreading more Joint Sand to fill the joints again, and vibrate accordingly, until all of the joints are completely full and Joint Sand material can no longer be swept or vibrated into the joints. Do not compact within six-feet (6') of an unrestrained edge.
- D. Activation of Bonding:
1. Prior to activation of Bonding, carefully sweep entire Unit Paving area clean to remove excess Joint Sand material from the surface. Excess Joint Sand material, including at chamfered areas, must be swept-off the paved surface and removed. Power broom or blowers are recommended for large areas.
 2. Sand level must be at least 1/8" below top of Unit Pavers.
 3. The Unit Paving area, including the joints, shall be moistened with a wide, light spray of water, applied in a continuous manner, allowing water to gently flow into the Unit Paving joints. For optimal results, wetting the surfaces shall take place in sections of 500 square-feet at a time. Ensure that the wetting of one (1) section is finished before wetting of another section. Care shall be exercised to avoid flooding the surface and causing a runoff, or displacing the Joint Sand from the joints.
 4. Do not use high pressure sprayers for flooding surfaces. Repeat water application 2-3 times at ten (10) minute intervals. Once the joints are moistened to their full depth, stop watering that section and move to the next section. Too much water will cause the polymer binders to run-off and prevent the Joint Sand from properly solidifying.
 5. Use a blower to blow the excess water off and help prevent white haze.
 6. To insure optimal cohesion and long-term stability, the Unit Paving area shall be allowed to become completely dry and free from traffic before being exposed to additional moisture. Drying time will be prolonged in cold and damp weather and can be considerably less in dry climates.
 7. Protect the area from traffic until activation has occurred.

11. UNIT PAVING TOLERANCES

- A. Base and Sub-Base Layers:
1. Top of base surface variation: +/- 3/8" over 10'-0" (non-cumulative).
 2. Compaction: Minimum 95% standard Proctor Density.
- B. Paver and Bedding Layers:
1. Paver Joint Width: 1/16 inch to max. 3/16".
 2. Paver surface flatness: +/- 3/8" in 10'-0" (non-cumulative).
 3. Lippage (edges of any two adjacent Unit Paving Modules): 1/8" maximum.
- C. Cut Pavers:
1. No less than 1/3 of paver size shall be cut.

12. APPLICATION OF UNIT PAVING SEALANT

- A. Penetrating Sealant: To be confirmed with Stone Supplier
1. Following installation of Unit Paving, apply Sealant to exposed Unit Paving surfaces with two (2) coats of the Penetrating Sealant. Apply in accordance with Manufacturer's written directions. Finished surfaces shall be uniform in appearance and not mottled.

11. Multi-Purpose Water-Based (Film-forming) Sealant:

2. Following installation of Unit Paving, apply Sealant to exposed Unit Paving surfaces with two (2) coats of the Multi-Purpose Water-Based (Film-forming) Sealant. Apply in accordance with Manufacturer's written directions. Finished surfaces shall be uniform in appearance and not mottled.

B. Multi-Purpose Solvent-Based (Film-forming) Sealant:

1. Following installation of Unit Paving, apply Sealant to exposed Unit Paving surfaces with two (2) coats of the Multi-Purpose Solvent-Based (Film-forming) Sealant. Apply in accordance with Manufacturer's written directions. Finished surfaces shall be uniform in appearance and not mottled.

13. REPAIR, CLEANING, AND PROTECTION

- A. Remove and replace Unit Paving materials that are loose, chipped, broken, stained, or otherwise damaged or if Units do not match adjoining units as intended. Provide new Units to match adjoining Units and install in same manner as original Units, with same joint treatment to eliminate evidence of replacement.
- B. Provide final protection and maintain conditions in a manner that insures that Work is without damage or deterioration at the time of Substantial Completion.
- C. Maintain finished surfaces free of stains, discoloration, dirt, and other foreign material until Final Acceptance of Work.

END OF SECTION

SECTION 321500 – AGGREGATE SURFACING

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete exterior Aggregate Surfacing installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Aggregate Surfacing Materials Aggregates.
 - 2. Weed Control Barrier/Geotextile Filter Fabric.
 - 3. Miscellaneous Materials (Herbicides, etc.).
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 312219 – Landscape Grading.
 - 2. Section 321313 – Concrete Paving.
 - 3. Section 329113 – Soil Preparation.
 - 4. Section 329300 – Exterior Plants.
 - 5. Section 329813 – Landscape Establishment Period.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ANSI – American National Standards Institute.
 - 2. ASTM – American Society for Testing and Materials.
 - 3. CBC – California Building Code, latest edition.
- B. Definitions:
 - 1. psi – pounds per square inch (measurement).
 - 2. cu/ft – cubic-feet/foot (measurement).
 - 3. oc – on-center (measurement).

3. SUBMITTALS

- A. General:
 - 1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 - 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 - 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

- B. Digital Submittal Information:
 - 1. Product/Material Data: Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
 - a. Aggregate Surfacing Material.
 - b. Weed Control Barrier/Geotextile Filter Fabric.
 - c. Herbicides.
 - 2. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar installations.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
 - 1. 0.50 cu/ft of Aggregate Surfacing Material (i.e. Aggregates, Boulders, Cobbles, Rubble, etc.) for each color and texture of material required for Project.
 - 2. One (1) two-foot (2'-0") square sample of Weed Control Barrier/Geotextile Filter Fabric.
- D. Scaled Shop Drawings: Not Required.
- E. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- F. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

4. QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications:
 - 1. Requirement: Valid **California** C-27 (Landscaping Contractor) License.
 - 2. Engage an experienced Installer who has completed Aggregate Surfacing work similar in material, design, and extent to that indicated for this Project, with a record of successful landscape performances for a minimum of three (3) consecutive years.
 - 3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on the Project site during times that installations under this Section are in progress.
- B. Single-Source Responsibility: Obtain each color, type, and variety of products/materials from a single source with resources to provide products/materials of consistent quality in appearance and physical properties without delaying Work.
- C. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, testing services, and inspections necessary to perform and complete Work under this Section.
- D. Field-Constructed Mock-up:

1. Prior to the installation of Work under this Section, Contractor shall erect a Field-Constructed Mock-up for Aggregate Surfacing, to be approved by the Landscape Architect, to verify selections made under this Article and to demonstrate aesthetic effects as well as qualities of materials and execution.
 2. Build Field-Constructed Mock-up using materials and same base construction including special features for surface finish and grouted joints as indicated for the final unit of Work:
 - a. Locate Field-Constructed Mock-up in a secure location as approved by the Landscape Architect. Mockups shall be separate and not included as a part of the completed Work.
 - b. Notify the Landscape Architect when Field-Constructed Mock-up will be erected.
 - c. Demonstrate quality and range of aesthetic effects and workmanship in the Field-Constructed Mock-up that will be produced in the final unit of Work.
 - d. Obtain the Landscape Architect's approval of the Field-Constructed Mock-up, in writing, before the start of Work. Approved Mock-up is a prerequisite to commencing Work under this Section.
 - e. Retain and maintain Field-Constructed Mock-up during construction in an undisturbed condition.
 - f. When directed by the Landscape Architect, demolish and remove Field-Constructed Mock-up.
 3. Size: Each Field-Constructed Mock-up for Aggregate Surfacing shall measure four-feet (4') wide and six-feet (6') long, to compare the aesthetics of material color, texture, and finish.
 - a. When the Landscape Architect determines that the Field-Constructed Mock-up does not meet requirements, retain it for reference and provide another Field-Constructed Mock-up until the Field-Constructed Mock-up is approved by the Landscape Architect.
 4. Approved Field-Constructed Mock-up will be the standard by which Work under this Section will be evaluated for technical and aesthetic merit.
5. DELIVERY, STORAGE, AND HANDLING
- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft or damage. Deliver and store perishable material in original, unopened packaging.
 - B. Damaged Materials: Be responsible for all damage or disfiguration of Work until Final Acceptance. Remove off site and replace at no additional cost to Owner all damaged or rejected materials.
 - C. Deliver materials so as to not delay Work, and install only after preparations for installation have been completed.
6. COORDINATION, SCHEDULING, AND OBSERVATIONS
- A. Utilities: Determine location of above-grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
 - B. Excavation: When conditions detrimental to installing Aggregate Surfacing are encountered, such as adverse drainage conditions or obstructions, cease installation operations and notify Landscape Architect for further direction.

- C. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.
- D. Installation: Perform installation of Aggregate Surfacing only when weather and soil conditions are suitable in accordance with locally accepted practices.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

8. LANDSCAPE ESTABLISHMENT PERIOD

- A. Refer to Section 329813 – Landscape Establishment Period, for requirements under this Article.

2.PRODUCTS

1. AGGREGATE SURFACING MATERIALS

- A. Aggregate Surfacing Materials:
 - 1. General: Hard, durable aggregates, washed free of loam, sand, clay, and other foreign substances or debris.
 - 2. Quantity: Provide and install in quantity required to provide acceptable depth and coverage as indicated on the Contract Drawings.

3. Material: Match approved referee sample, as acquired by the Landscape Architect, to compare for material, color, texture, size, and other characteristics relating to aesthetic effects.
 - a. Type: **Gravel Mulch**
 - b. Size: **3/8"**
 - c. **Color: Pewter Grey**
 - d. Products & Manufacturer's: Subject to compliance with requirements, provide products by the following:
 - 1) **Southwest Boulder and Stone.**
 - 2) Or equal, as approved by the Landscape Architect.
2. WEED CONTROL BARRIER/GEO-TEXTILE FILTER FABRIC
 - A. Type: Permeable, lightweight, continuous, non-woven, geo-textile polypropylene filament material, UV-resistant, engineered to allow water permeability and deter soil permittivity, per ASTM D4491. Geo-Textile Filter Fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis and acids. Meet AASHTO M288-96, Class 1.
 - B. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 1. *Amoco 4553*, Amoco Fabrics and Fibers Company.
 2. *FX-80HS*, Carthage Mills.
 3. *C-80NW*, Contech.
 4. *180 EX*, Linq.
 5. *Geotex 801*, Propex, Inc.
 6. *TerraTex N08*, Webtec.
 7. *180N*, TC Mirafi.
 8. *3301*, Typar Landscape Products.
 9. or equal, as approved by the Landscape Architect.
3. MISCELLANEOUS MATERIALS
 - A. Herbicide: EPA registered and approved, from the following:
 1. Non-Selective Post-Emergent Herbicide: Spray-applied solution containing a minimum of 41% of the active ingredient "glyphosate" (full strength), with a surfactant, mixed with water accordingly per the Manufacturer's directions.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Roundup® PRO*, (41% glyphosate), Monsanto Company, St. Louis, MO.
 - 2) *Roundup® PRO Concentrate* (50% glyphosate), Monsanto Company, St. Louis, MO.
 - 3) *Honcho® Plus*, (41% glyphosate), Monsanto Company, St. Louis, MO.
 - 4) *High Yield® Kill-Zall Weed & Grass Killer*, (41% glyphosate), Voluntary Purchasing Groups, Boneham, TX.
 - 5) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Apply at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.

3.EXECUTION

1. GENERAL

- A. Installation practices of the Aggregate Surfacing shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practice, as approved by the Landscape Architect. Contractor shall notify the Landscape Architect, in writing, on the anticipated commencement date and length of duration of the landscape installation.
- B. Examination: Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of Work of this Section. No Work under this Section shall commence until all Submittals under this section have been reviewed and approved, in writing.
- C. Prior to Work in this Section, Contractor shall examine previously installed Work related to other Sections and verify that such Work is complete and as required, to the point where the installation of the Aggregate Surfacing materials may commence properly.

2. PROTECTION OF SITE

- A. Contractor shall protect existing and new improvements and systems installed prior to installation of Aggregate Surfacing. Maintain protection in place until completion of Work and Landscape Establishment Period.

3. INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Herbicides: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions, prior to the installation of the Aggregate Surfacing material.

4. INSTALLATION OF AGGREGATE SURFACING MATERIALS

- A. General: Backfill surfaces of pits, trenches, planted areas, and other areas indicated to appropriate finished grades.
- B. Compact Sub-grade per recommendation of Geotechnical Engineer. Match compaction density for Concrete Paving-type applications.
- C. Aggregate Surfacing:
 - 1. Aggregate Surfacing consists of loose aggregate material placed on a layer of Geotextile Filter Fabric which is pinned to the compacted surface of the sub grade. Apply Aggregate Surfacing in the specified areas on the Contract Drawings, with the finished grade of the Aggregate Surfacing level with adjacent finished surfaces.
 - a. Geotextile Filter Fabric: Install Fabric according to the Manufacturer's recommendations over compacted sub grade and prior to placement of Aggregate Surfacing. Completely cover mulched area, lapping Fabric edges a minimum of six-inches (6"). Tack/pin into place using steel staples, set at thirty-six-inches (36") O.C. maximum along perimeter.
 - b. Spread Aggregate Surfacing evenly throughout all areas designated to receive the Aggregate Surfacing at the following thickness and rates:
 - 1) Thickness: Minimum three-inches (3") thick. Depth of Aggregate Surfacing shall be adequate to thoroughly cover the Geotextile Filter Fabric.

2. Protect Plant Materials during installation of Aggregate Surfacing; do not place Aggregate Surfacing against the trunks or stems of plants. Remove Aggregate Surfacing that is placed against the growing bases or within the basal nodes of the plants.
3. Plant Materials that are damaged during this operation, at the sole opinion of the Landscape Architect, shall be replaced accordingly at the Contractor's expense.
4. Replace Aggregate Surfacing that is unlike in character (color, size, texture). Defective, fractured, stained, or material which does not meet the requirements herein in this Section shall be removed and replaced with appropriate Aggregate Surfacing material as specified.
5. Rake Aggregate Surfacing surfaces smooth, consistent, and level, with no depressions, voids, rills, footprints, etc. Fines from the Aggregate Surfacing that are located on the finished surface shall be raked and/or removed accordingly to establish a clean, consistent Aggregate Surfacing finish.
6. Maintain Aggregate Surfacing free of stains, weeds, discoloration, trash, fines, debris, soil, sand, or other foreign material.
 - a. Contractor shall exercise care so as not to contaminate Aggregate Surfacing with Shredded Wood Mulches, plant materials, soil, or other foreign substances.
 - b. Soil that has contaminated the Aggregate Surfacing areas shall be removed from the Aggregate Surfacing. Raking to "hide" the soil below the finished surface of the Aggregate Surfacing is not acceptable.

D. Aggregate Surfacing:

1. Clean Aggregate Surfacing units free from dirt, dust, debris, etc.
2. Set Aggregate Surfacing in the specified areas on the Contract Drawings, with the finished grade of the Aggregate Surfacing per the Contract Drawings.
3. Mix and spread Setting Mortar at the minimum depth indicated in the Contract Drawings.
4. Hand-set Aggregate Surfacing evenly throughout all areas designated to receive the Aggregate Surfacing. Firmly set Aggregate Surfacing Units into plastic Mortar, with tight joint spacing between Aggregate Surfacing units. Joint tolerances as indicated on the Contract Drawings.
5. After Setting Mortar has sufficiently hardened, apply additional Mortar as needed for grouting between Aggregate Surfacing Units to tolerances indicated. Rake joints as needed to expose Aggregate Surfacing. Remove excess grouting.
6. Performance Specification: Design intent is to minimize the visual appearance of the exposed surface grouting between the Aggregate Surfacing Units, and maximize the visual composition appearance of the exposed Aggregate Surfacing Units.
7. Replace Aggregate Surfacing that is unlike in character (color, size, texture). Defective, fractured, stained, or material which does not meet the requirements herein in this Section shall be removed and replaced with appropriate Aggregate Surfacing material as specified.

5. CLEAN UP AND PROTECTION

- A. For Work under this Section, keep Work area in a clean, orderly, and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect landscaping from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and Landscape Establishment Period. Treat, repair, or replace damaged Aggregate Surfacing as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, and other items resulting from construction operations offsite as described herein in this Section and directed by the Landscape Architect.

6. FINAL REVIEW

- A. Final Review under this Section shall be performed upon completion of the Landscape Establishment Period. (Refer to Section 329813 – Landscape Establishment Period for requirements).

END OF SECTION

SECTION 32 84 00 - LANDSCAPE IRRIGATION

PART 1 - GENERAL

1. SUMMARY

- A. It is the intent of the specifications and drawings that the finished system is complete in every respect.
- B. The work shall include all materials, labor, services, transportation, and equipment necessary to perform the work as indicated on the drawings, in these specifications, and as necessary to complete the contract.
- C. Secure the required licenses and permits including payments of charges and fees, give required notices to public authorities and verify permits secured or arrangements made by others affecting the work of this section.

2. CONSTRUCTION DRAWINGS

- A. Offsets, fittings, sleeves, etc. which may be required are not shown on the drawings. Carefully investigate the structural and finished conditions affecting the work and plan the work accordingly, furnishing such fittings, etc. as may be required to meet such conditions. The work shall be installed in such a manner as to avoid conflicts between irrigation systems, planting, and architectural features.
- B. Work called for on the drawings by notes or details shall be furnished and installed whether or not specifically mentioned in the specifications. When an item is shown on the plans but not shown on the specifications or vice versa, it shall be deemed to be as shown on both. The Architect shall have final authority for clarification.
- C. Do not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been considered in engineering. Such obstructions or differences should be brought to the attention of the Architect as soon as detected. In the event this notification is not performed, the Contractor shall assume full responsibility for any revision necessary.

3. QUALITY ASSURANCE

- A. Provide at least one English speaking person who shall be present at all times during execution of this portion of the work and who shall be thoroughly familiar with the type of materials being installed and the manufacturer's recommended methods of installation and who shall direct all work performed under this section.
- B. Manufacturer's directions and detailed drawings shall be followed in all cases where the manufacturer of articles used in this contract furnish directions covering points not shown in the drawings and specifications.

- C. Local, municipal, and state laws, rules and regulations governing or relating to any portion of this work are hereby incorporated into and made a part of these specifications, and their provisions shall be carried out by the Contractor. Anything contained in these specifications shall not be construed to conflict with any of the above rules and regulations of the same. However, when these specifications and drawings call for or describe materials, workmanship, or construction of a better quality, higher standard, or larger size than is required by the above rules and regulations, the provisions of these specifications and drawings shall take precedence.
- D. All materials supplied for this project shall be new and free from any defects. All defective materials shall be replaced immediately at no additional cost.

4. SUBMITTALS

A. Water Pressure Test:

- 1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the Architect a written verification of the existing water pressure on the project at each of the points of connection shown.
- 2. The water pressure test shall be performed to measure the dynamic water pressure at the point of connection at the maximum flow rate of the proposed irrigation system as shown on the point of connection note. Dynamic water pressure is when water is flowing through the point of connection. Static water pressure readings when water is not flowing, are not acceptable.
- 3. Written dynamic water pressure test confirmation shall be made on the contractor's letterhead and include the flow rate during the test, the recorded water pressure, the date of the test and the time of the test.

B. Material List:

- 1. After award of contract and before any irrigation system materials are ordered from suppliers or delivered to the job site, submit to the Architect a complete list of all irrigation system materials, or processes proposed to be furnished and installed as part of this contract.
- 2. The submittal materials list shall include the following information:
 - a. A title sheet with the job name, the contractor's name, contractor's address and telephone number, submittal date and submittal number.
 - b. An index sheet showing the item number (e.g. 1,2,3, etc.); an item description (e.g. sprinkler head); the manufacturer's name (e.g. Hunter Industries); the item model number (e.g. I-40-ADV/36V); and the page(s) in the submittal set that contain the catalog cuts.
 - c. The catalog cuts shall be one or two pages copied from the most recent manufacturer's catalog that indicate the product submitted. Do not submit parts lists, exploded diagrams, price lists or other extra information.
 - d. The catalog cuts shall clearly indicate the manufacturer's name and the item model number. The item model number, all specified options and specified sizes shall be circled on the catalog cuts.
 - e. Submittals for equipment indicated on the legend without manufacturer names, or "as approved", shall contain the manufacturer, Class or Schedule, ASTM numbers and/or other certifications as indicated in these specifications.

3. Submittal materials list format requirements:
 - a. Submittals shall be provided as one complete package for the project in electronic pdf format. Multiple partial submittals will not be reviewed.
 - b. Submittal package shall have all pages numbered in the lower right hand corner. Page numbers shall correspond with submittal index.
 - c. Re-submitted packages must be revised to include only the equipment being re-submitted. Equipment previously reviewed and accepted shall not be re-submitted in the materials list/index sheet or in the catalog cut sheet package.
- C. Substitutions: If the Contractor wishes to substitute any equipment or materials for those equipment or materials listed on the irrigation drawings and specifications, they may do so by providing the following information to the Architect for approval.
 1. Provide a written statement indicating the reason for making the substitution.
 2. Provide catalog cut sheets, technical data, and performance information for each substitute item.
 3. Provide in writing the difference in installed price if the item is accepted.
- D. The Architect will allow no substitutions without prior written acceptance
- E. Manufacturer's warranties shall not relieve the Contractor of their liability under the guarantee. Such warranties shall only supplement the guarantee.
- F. The Architect will not review the submittal package unless provided in the format described above.
5. INSPECTIONS
 - A. Permit the Architect to visit and inspect at all times any part of the work and shall provide safe access for such visits.
 - B. Where the specifications require work to be tested, it shall not be covered over until accepted by the Architect and/or governing agencies. The Contractor shall be solely responsible for notifying the Architect and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing. Should any work be covered without testing or acceptance, it shall be, if so ordered, uncovered at the Contractor's expense.
 - C. Inspections will be required for the following at a minimum:
 1. Pre-construction meeting.
 2. System layout.
 3. Pressure test of irrigation mainline (Four hours at 125 PSI or 120% of static water pressure, whichever is greater.) Mainline pressure loss during test shall not exceed 2 PSI.
 4. Coverage test of irrigation system. Test shall be performed prior to any planting.
 5. Final inspection prior to start of maintenance period.
 6. Final acceptance prior to turnover.

- D. Site observations and testing will not commence without the field record drawings as prepared by the Contractor. Record drawings must be complete and up to date for each site visit.
- E. Work that fails testing and is not accepted will be retested. Hourly rates and expenses of the Architect for re-inspection or retesting will be paid by the Contractor at no additional cost.

6. EXISTING CONDITIONS

- A. Verify and be familiar with the locations, size and detail of points of connection provided as the source of water and electrical supply connection to the irrigation system.
- B. Irrigation design is based on the available static water pressure shown on the drawings. Verify static water on the project prior to the start of construction. Should a discrepancy exist, notify the Architect prior to beginning construction.
- C. Prior to cutting into the soil, locate all cables, conduits, sewer septic tanks, and other utilities as are commonly encountered underground, and take proper precautions not to damage or disturb such improvements. If a conflict exists between such obstacles and the proposed work, promptly notify the Architect who will arrange for relocations. Proceed in the same manner if a rock layer or any other such conditions are encountered.
- D. Protect all existing utilities and features to remain on and adjacent to the project site during construction. Repair, at no additional cost, all damage resulting from their operations or negligence.
- E. Coordinate with the General Contractor for installation of required sleeving as shown on the plans prior to paving operations.
- F. Verify and be familiar with the existing irrigation systems in areas adjacent to and within the Project area of work.
- G. Protect all existing irrigation systems, in areas adjacent to and within the project area of work, from damage due to his operations.
- H. Notify Architect if any existing system is temporarily shut off, capped or modified. Provide 48-hour notice, prior to turning off or modifying any existing irrigation system.
- I. Repair or replace all existing irrigation systems, in areas adjacent to and within the project area of work, damaged by the construction of this project. Adjacent irrigation systems shall be made completely operational and provide complete coverage of the existing landscaped areas. All repairs shall be complete to the satisfaction of the Architect.

7. STORAGE AND HANDLING

- A. Use all means necessary to protect irrigation system materials before, during, and after installation and to protect the installation work and materials of all other trades. In the event of damage, immediately make all repairs and replacements necessary to the acceptance of the Architect at no additional cost.
- B. Exercise care in handling, loading, unloading, and storing plastic pipe and fittings under cover until ready to install. Transport plastic pipe only on a vehicle with a bed long enough to allow the pipe to lay flat to avoid undue bending and concentrated external load.

8. CLEANUP AND DISPOSAL

- A. Dispose of waste, trash, and debris in accordance with applicable laws and ordinances and as prescribed by authorities having jurisdiction. Bury no waste material and debris on the site. Burning of trash and debris will not be permitted. Remove and dispose of rubbish and debris at frequent intervals or when ordered to do so by the Architect.
- B. At the time of completion, the entire site will be cleared of tools, equipment, rubbish and debris which shall be disposed of off-site in a legal disposal area.

9. TURNOVER ITEMS

- A. Record Drawings:
 - 1. Record accurately on one set of drawings all changes in the work constituting departures from the original contract drawings and the actual final installed locations of all required components as shown below.
 - 2. The record drawings shall be prepared to the satisfaction of the Architect. Prior to final inspection of work, submit record drawings to Architect.
 - 3. Record drawings shall be prepared using AutoCAD 2024 drafting software and the original irrigation drawings as a base. No manual drafted record drawings shall be acceptable. Obtain digital base files from the Architect.
 - 4. Prior to final inspection of work, submit record drawings plotted as PDF digital file for review by the Architect. After acceptance by the Architect plot the record drawings onto bond paper sheets. Also provide record drawing information on a digital AutoCAD Release 2024 drawing file. All digital files shall be provided on a memory stick clearly marked with the project name, file descriptions and date.
 - a. Record drawing information and dimensions shall be collected on a day-to-day basis during the installation of the pressure mainline to fully indicate all routing locations and pipe depths. Locations for all other irrigation equipment shall be collected prior to the final inspection of the work.
 - b. Two dimensions from two permanent points of reference, such as buildings, sidewalks, curbs, streetlights, hydrants, etc. shall be shown for each piece of irrigation equipment shown below. Where multiple components are installed with no reasonable reference point between the components, dimensioning may be made to the irrigation equipment. All irrigation symbols shall be clearly shown matching the irrigation legend for the drawings. All lettering on the record drawings shall be minimum 1/8 inch in size.

5. Show locations and depths of the following items:
 - a. Point of connection (including water POC, backflow devices, master control valves, flow sensors, etc.)
 - b. Routing of sprinkler pressure main lines (dimensions shown at a maximum of 100 feet along routing)
 - c. Isolation valves
 - d. Automatic remote control valves (indicate station number and size)
 - e. Quick coupling valves
 - f. Drip air relief and flush valves
 - g. Routing of control wires where separate from irrigation mainline
 - h. Irrigation controllers (indicate controller number and station count)
 - i. Related equipment (as may be directed)

B. Controller Charts:

1. Provide one controller chart for each automatic controller. Chart shall show the area covered by the particular controller. The areas covered by the individual control valves shall be indicated using colored highlighter pens. A minimum of six individual colors shall be used for the controller chart unless less than six control valves are indicated.
2. Architect must approve record drawings before controller charts are prepared.
3. The chart is to be a reduced copy of the actual "record" drawing. In the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a readable size.
4. When completed and approved, the chart shall be hermetically sealed between two pieces of plastic, each piece being a minimum 20 mils in thickness.

C. Equipment:

1. Supply as a part of this contract the following items:
 - a. Three 30-inch sprinkler keys for manual operation of control valves.
 - b. Two keys for each automatic controller.
 - c. Two quick coupler keys with a 1" bronze hose bib, bent nose type with hand wheel and two coupler lid keys.
 - d. One valve box cover key or wrench.
 - e. Six extra sprinkler heads of each size and type.
 - f. For specified ball valves if required: One (1) 5-foot long valve handle, to fit the specified ball valves.
 - g. One hundred feet of drip tubing of each size and type.
 - h. Twenty-five barbed drip tubing fittings of each TEEs. Couplings, elbows, and male adapters.
 - i. One hundred drip tubing stakes.
2. The above equipment shall be turned over to Architect at the final inspection.

10. COMPLETION

- A. At the time of the pre-maintenance period inspection, the Architect and governing agencies will inspect the work, and if not accepted, will prepare a list of items to be completed by the Contractor. Punch list to be checked off by contractor and submitted to Architect prior to any follow-up meeting. This checked off list to indicate that all punch list items have been completed. At the time of the post-maintenance period or final

inspection the work will be re-inspected, and final acceptance will be in writing by the Architect and governing agencies.

- B. The Architect shall have final authority on all portions of the work.
- C. After the system has been completed, instruct Architect in the operation and maintenance of the irrigation system.
- D. Any settling of trenches which may occur during the one-year period following acceptance shall be repaired to the Architect's satisfaction at no additional cost. Repairs shall include the complete restoration of all damage to planting, paving or other improvements of any kind as a result of the work.

11. GUARANTEE

- A. The entire sprinkler system, including all work done under this contract, shall be unconditionally guaranteed against all defects and fault of material and workmanship, including settling of backfilled areas below grade, for a period of one (1) year following the filing of the Notice of Completion.
- B. Should any problem with the irrigation system be discovered within the guarantee period, it shall be corrected by the Contractor at no additional cost within ten (10) calendar days of receipt of written notice from Architect. When the nature of the repairs as determined by the Architect constitute an emergency (i.e. broken pressure line) the Architect may proceed to make repairs at the Contractor's expense. Any and all damages to existing improvement resulting either from faulty materials or workmanship, or from the necessary repairs to correct same, shall be repaired to the satisfaction of the Architect at no additional cost.
- C. Guarantee shall be submitted on Contractor's own letterhead as follows:

GUARANTEE FOR SPRINKLER IRRIGATION SYSTEM

We hereby guarantee that the sprinkler irrigation system we have furnished and installed is free from defects in materials and workmanship, and the work has been completed in accordance with the drawings and specifications, ordinary wear and tear and unusual abuse, or neglect excepted. We agree to repair or replace any defective material during the period of one year from date of filing of the Notice of Completion and also to repair or replace any damage resulting from the repairing or replacing of such defects at no additional cost to the Architect. We shall make such repairs or replacements within 10 calendar days following written notification by the Architect. In the event of our failure to make such repairs or replacements within the time specified after receipt of written notice from Architect, we authorize the Architect to proceed to have said repairs or replacements made at our expense and we will pay the costs and charges therefore upon demand.

PROJECT NAME:

PROJECT LOCATION:

CONTRACTOR NAME:
ADDRESS:

TELEPHONE:

SIGNED:

DATE:

PART 2 - MATERIALS

1. SUMMARY

- A. Use only new materials of the manufacturer, size and type shown on the drawings and specifications. Materials or equipment installed or furnished that do not meet Architect's will be rejected and shall be removed from the site at no additional expense.

2. PIPE

- A. Pressure supply lines 3 inches in diameter and larger downstream of the backflow unit shall be Class 200 bell and gasket PVC conforming to ASTM 2672.
- B. Non-pressure lines 3/4 inch in diameter and larger downstream of the remote control valve shall be SCH 40 solvent weld PVC conforming to ASTM D1785.
- C. Recycled water PVC pipe to be color-coded purple in color marked on two sides with recycled water warning statements "Caution-Recycled Water". Recycled water piping must be accepted by the local recycled water governing agencies.

3. PLASTIC PIPE FITTINGS

- A. Pipe shall be marked continuously with manufacturer's name, nominal pipe size, schedule or class, PVC type and grade, National Sanitation Foundation approval, Commercial Standards designation, and date of extrusion.
- B. All plastic pipe shall be extruded of an improved PVC virgin pipe compound in accordance with ASTM D2672, ASTM D2241 or ASTM D1785.
- C. All solvent weld PVC fittings shall be standard weight Schedule 40 (and Schedule 80 where specified on the irrigation detail sheet, all mainline fittings shall be Schedule 80 PVC) and shall be injection molded of an improved virgin PVC fitting compound. Slip PVC fittings shall be the "deep socket" bracketed type. Threaded plastic fittings shall be injection molded. All tees and ells shall be side gated. All fittings shall conform to ASTM D2464 and ASTM D2466.
- D. All threaded nipples shall be standard weight Schedule 80 with molded threads and shall conform to ASTM D1785.

- E. All solvent cementing of plastic pipe and fittings shall be a two-step process, using primer and solvent cement applied per the manufacturer's recommendations. Cement shall be of a fluid consistency, not gel-like or ropy. Solvent cementing shall be in conformance with ASTM D2564 and ASTM D2855.
- F. When connection is plastic to metal, female adapters shall be hand tightened, plus one turn with a strap wrench. Joint compound shall be non-lead base Teflon paste, tape, or equal.
- G. All pressure mainlines installed with solvent weld PVC fittings shall be installed with concrete thrust blocking at all directional changes in the mainline routing. Concrete thrust blocking shall not be required when ductile iron fittings and mechanical restraints are specified.
- H. PVC fittings used with UVR pipe shall be Schedule 40 UVR PVC type.

4. BELL AND GASKET FITTINGS

- A. Fittings for bell and gasket pressure supply lines shall be ductile iron deep bell type. Fittings shall be manufactured of ductile iron, Grade 65-45-12 in accordance with ASTM A-536. Fitting gaskets shall be in accordance with ASTM F-477. All ductile iron fittings shall be manufactured with exterior lugs. Ductile iron fittings shall be as manufactured by Leemco, Inc., Corona, California.
- B. All tee fittings used to connect remote control valve assemblies and quick coupler assemblies to the mainline shall be ductile iron deep bell type. The outlet side of the tee or ell to the valve assembly shall be sized per the diameter of the largest valve in the assembly or a minimum of 2 inches. Ductile iron deep bell type reducers when used with bolt on links are allowable in lieu of reducing tee or ells. The PVC pipe to the valve assembly shall be secured to the ductile iron fitting using a joint restraint.
- C. All ductile iron fittings and all bell and gasket joints within fifty (50) feet of a directional change in the mainline shall be equipped with mechanical joint restraints. The joint restraint shall be capable of securing the PVC pipe directly to the lugs on the ductile iron fittings without the use of bolts, links and adapters. The joint restraint shall be capable of securing PVC pipe to PVC pipe and PVC pipe to ring joint isolation valves without the use of threaded linkages. Joint restraints shall be as manufactured by Leemco, Inc., Corona, California.

5. BACKFLOW PREVENTION UNITS

- A. The backflow prevention unit shall be existing as indicated on the drawings.
- B. The existing backflow prevention unit shall be installed in accordance with the requirements set forth by local codes.

6. VALVES

- A. Gate Valves:

1. Gate valves shall be of the manufacturer, size, and type indicated on the drawings.
 2. Gate valves shall be constructed of a bronze body, gate and stem. Gate valves shall have threaded connections.
 3. All gate valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA standards.
- B. Ball Valves:
1. Ball valves shall be of the manufacturer, size, and type indicated on the drawings.
 2. Ball valves shall be constructed of a bronze or stainless steel body, stainless steel ball and stem. Ball valves shall have threaded connections.
 3. All ball valves shall have a minimum working pressure of not less than 150 PSI and shall conform to AWWA standards.
- C. Quick Coupler Valves:
1. Quick coupler valves shall be of the manufacturer, size, and type indicated on the drawings.
 2. Quick coupler valves shall be brass with a wall thickness guaranteed to withstand normal working pressure of 150 psi without leakage. Valves shall have 1" female threads opening at base, with two-piece body. Valves to be operated only with a coupler key, designed for that purpose. Coupler key is inserted into valve and a positive, watertight connection shall be made between the coupler key and valve.
 3. Vinyl quick coupler cover to be purple in color with the words "Warning-Recycled Water-Do Not Drink" permanently marked on lid.
- D. Remote Control Valves:
1. Automatic control valves shall be of the manufacturer, size, and type indicated on the drawings.
 2. Automatic control valves shall be electrically operated.
 3. Provide Christy's valve ID tags for each remote control valve with valve number.
7. VALVE BOXES
- A. Valve boxes shall be fabricated from a durable, weather-resistant plastic material resistant to sunlight and chemical action of soils.
- B. The valve box cover shall be purple in color and secured with a hidden latch mechanism or bolts.
- C. Valve box extensions shall be by the same manufacturer as the valve box.
- D. The plastic irrigation valve box cover shall be an overlapping type.
- E. Automatic control valve boxes shall be 17"x11"x12" 'nominal' rectangular size. Valve boxes for drip valve assemblies shall be Jumbo valve boxes size as required to fit assemblies. Valve box covers shall be marked "RCV" with the valve identification number "heat branded" onto the cover in 1-1/4 inch high letters / numbers.
- F. Quick coupler and ball valve boxes shall be 10" circular size. Valve box covers shall be marked with "QCV" or "BV" "heat branded" onto the cover in 1-1/4 inch high letters.

- G. Valve box cover shall be green in color and permanently marked (attached tags are not acceptable) on valve box cover plate with the words "Warning-Recycled Water-Do Not Drink".

8. IRRIGATION HEADS AND INLINE DRIP TUBING

- A. Irrigation heads and inline drip tubing shall be of the manufacturer, size, type, with radius of throw, operating pressure, and discharge rate indicated on the drawings.
- B. Irrigation heads and inline drip tubing shall be used as indicated on the drawings.
- C. Irrigation heads shall have purple recycled water warning cover.

9. DRIP IRRIGATION EQUIPMENT

- A. Drip tubing equipment such as flush valves, air relief valves, wye strainers and pressure regulators shall be of the manufacturer, size, and type indicated on the drawings.

10. AUTOMATIC CONTROLLER

- A. Automatic controller shall existing as indicated on the drawings.
- B. The existing controller shall be grounded according to local codes using equipment of the manufacturer, size, and type indicated on the drawings; or as required by local codes and ordinances.

11. LOW VOLTAGE CONTROL WIRING

- A. Remote control wire shall be direct-burial AWG-UF type, size as indicated on the drawings, and in no case smaller than 14 gauge.
- B. Remote control wire shall be 14 AWG solid core twisted pair, type as indicated on the irrigation drawings.
- C. Waterproof connections shall of the manufacturer, size, and type indicated on the drawings.
- D. Common wires shall be white in color. Control wires shall be red (where two or more controllers are used, the control wires shall be a different color for each controller. These colors shall be noted on the "Record Drawings" plans located on controller door).
- E. Ground wires shall be green in color or bare copper and in no case smaller than 6 gauge.

12. MISCELLANEOUS EQUIPMENT

- A. Landscape Fabric:
 - 1. Landscape fabric for valve box assemblies shall be 5.0- oz. weight woven polypropylene weed barrier. Landscape fabric shall have a burst strength of 225 PSI, a puncture strength of 60 lbs. and capable of water flow of 12 gallons per minute per square foot.

2. Type: DeWitt Pro 5 Weed Barrier or approved equal.
- B. Equipment such as flow sensors, rain sensors, freeze sensors, flush valves, air relief valves, wye strainers, and master valves shall be of the manufacturer, size and type indicated on the drawings.

PART 3 - EXECUTION

1. SITE CONDITIONS

- A. Inspections:
 1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 2. Verify that irrigation system may be installed in strict accordance with all pertinent codes and regulations, the original design, the referenced standards, and the manufacturer's recommendations.
- B. Discrepancies:
 1. In the event of discrepancy, immediately notify the Landscape Architect or **Architect**'s authorized representative.
 2. Do not proceed with installation in areas of discrepancy until all discrepancies have been resolved.
- C. Grades:
 1. Before starting work, carefully check all grades to determine that work may safely proceed, keeping within the specified material depths with respect to finish grade.
 2. Final grades shall be accepted by the Engineer before work on this section will be allowed to begin.
- D. Field Measurements:
 1. Make all necessary measurements in the field to ensure precise fit of items in accordance with the original design. Contractor shall coordinate the installation of all irrigation materials with all other work.
 2. All scaled dimensions are approximate. The Contractor shall check and verify all size dimensions prior to proceeding with work under this section.
 3. Exercise extreme care in excavating and working near existing utilities. Contractor shall be responsible for damages to utilities, which are caused by his operations or neglect.
- E. Diagrammatic Intent:
 1. The drawings are essentially diagrammatic. The size and location of equipment and fixtures are drawn to scale where possible. Provide offsets in piping and changes in equipment locations as necessary to conform with structures and to avoid obstructions or conflicts with other work at no additional expense to **Architect**.
- F. Layout:

1. Prior to installation, the Contractor shall stake out all pressure supply lines, routing and location of sprinkler heads, valves, **backflow preventer**, and automatic controller.
 2. Layout irrigation system and make minor adjustments required due to differences between site and drawings. Where piping is shown on drawings under paved areas, but running parallel and adjacent to planted areas, install the piping in the planted areas.
- G. Water Supply:
1. Connections to, or the installation of, the water supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to **Architect**.
- H. Electrical Service:
1. Connections to the electrical supply shall be at the locations shown on the drawings. Minor changes caused by actual site conditions shall be made at no additional expense to **Architect**.
 2. Contractor shall make electrical connections to the irrigation controller. Electrical power source to controller locations shall be provided by others.
 3. Contractor shall make electrical connections to the irrigation controller. 230-volt single-phase electrical power source to pump assembly location shall be provided by others per NEC codes.
2. TRENCHING
- A. Excavations shall be straight with vertical sides, even grade, and support pipe continuously on bottom of trench. Trenching excavation shall follow layout indicated on drawings to the depths below finished grade and as noted. Where lines occur under paved area, these dimensions shall be considered below subgrade.
- B. Provide minimum cover of 18 inches on pressure supply lines 2 ½ inches and smaller.
- C. Provide minimum cover of 24 inches on pressure supply lines 3 inches and larger.
- D. Provide minimum cover of 18 inches for control wires within planters.
- E. Provide minimum cover of 24 inches for control wires within sleeves below paving.
- F. Provide minimum cover of 36 inches on pressure supply lines under vehicular travel ways.
- G. Provide minimum cover of 12 inches for non-pressure lines.
- H. Pipes installed in a common trench shall have a 4-inch minimum space between pipes.
3. THRUST BLOCKS
- A. Thrust blocks must be constructed of Class "B" concrete.

- B. Thrust blocks shall be poured against undisturbed site soil.
- C. PVC fitting joints shall be kept free of concrete. Do not encase fitting in concrete.
- D. Thrust blocking shall be sized to provide the minimum bearing areas as shown below. Bearing areas indicated have been calculated for Class 200 PVC pipe at a test pressure of 150 PSI in soil with 2,000 PSI bearing capacity. Increase thrust block sizing as necessary for varying soil conditions.
 - 1. Provide a minimum thrust block bearing area of **2.0 square feet** on all bends (all degrees) and tees installed on pressure supply lines 4 inches and smaller.
 - 2. Provide a minimum thrust block bearing area of **4.0 square feet** on all 90 degree bends installed on pressure supply lines 6 inches in size. Bends of less than 90 degrees shall require a thrust block with a bearing area of **2.0 square feet** for 6 inch mainline.
 - 3. Provide a minimum thrust block bearing area of **3.0 square feet** on all tees installed on pressure supply lines 6 inches in size.
 - 4. Provide a minimum thrust block bearing area of **6.5 square feet** on all 90 degree bends installed on pressure supply lines 8 inches in size. Bends of less than 90 degrees shall require a thrust block with a bearing area of **3.5 square feet** for 8 inch mainline.
 - 5. Provide a minimum thrust block bearing area of **4.5 square feet** on all tees installed on pressure supply lines 8 inches in size.

4. BACKFILLING

- A. Backfill material on all lines shall be the same as adjacent soil free of debris, litter, and rocks over 1/2 inches in diameter.
- B. Backfill shall be tamped in 4-inch layers under the pipe and uniformly on both sides for the full width of the trench and the full length of the pipe. Backfill materials shall be sufficiently damp to permit thorough compaction, free of voids. Backfill shall be compacted to dry density equal to adjacent undisturbed soil and shall conform to adjacent grades.
- C. Flooding in lieu of tamping is not allowed.
- D. Under no circumstances shall truck wheels be used to compact backfill.
- E. Provide sand backfill a minimum of 4 inches over and under all piping under paved areas.

5. PIPING

- A. Piping under existing pavement may be installed by jacking, boring, or hydraulic driving. No hydraulic driving is permitted under asphalt pavement.
- B. Cutting or breaking of existing pavement is not permitted.

- C. Carefully inspect all pipe and fittings before installation, removing dirt, scale, burrs, and reaming. Install pipe with all markings up for visual inspection and verification.
- D. Remove all dented and damaged pipe sections.
- E. All lines shall have a minimum clearance of 4 inches from each other and 12 inches from lines of other trades.
- F. Parallel lines shall not be installed directly over each other.
- G. In solvent welding, use only the specified primer and solvent cement and make all joints in strict accordance with the manufacturer's recommended methods including wiping all excess solvent from each weld. Allow solvent welds at least 15 minutes setup time before moving or handling and 24 hours curing time before filling.
- H. PVC pipe shall be installed in a manner, which will provide for expansion and contraction as recommended by the pipe manufacturer.
- I. Center load all plastic pipe prior to pressure testing.
- J. All threaded plastic-to-plastic connections shall be assembled using Teflon tape or Teflon paste.
- K. For plastic-to-metal connections, work the metal connections first. Use a non-hardening pipe dope on all threaded plastic-to-metal connections, except where noted otherwise. All plastic-to-metal connections shall be made with plastic male adapters.

6. CONTROLLER

- A. The exact location of the existing controller shall be field verified with the Landscape Architect or **owner's** authorized representative before installation. The electrical service shall be coordinated with this location.
- B. The irrigation system shall be programmed to operate during the periods of minimal use of the design area.

7. CONTROL WIRING

- A. Low voltage control wiring shall occupy the same trench and shall be installed along the same route as the pressure supply lines whenever possible.
- B. Where more than one wire is placed in a trench, the wiring shall be taped together in a bundle at intervals of 10 feet. Bundle shall be secured to the mainline with tape at intervals of 20 feet.
- C. All connections shall be of an approved type and shall occur in a valve box. Provide an 18-inch service loop at each connection.

- D. An expansion loop of 12 inches shall be provided at each wire connection and/or directional change, and one of 24 inches shall be provided at each remote control valve.
- E. A continuous run of wire shall be used between a controller and each remote control valve. Under no circumstances shall splices be used without prior approval.

8. VALVES

- A. Automatic control valves, quick coupler, and ball valves are to be installed in the approximate locations indicated on the drawings.
- B. Valve shall be installed in shrub areas whenever possible.
- C. Install all valves as indicated in the detail drawings.
- D. Valves to be installed in valve boxes shall be installed one valve per box.
- E. Provide valve ID tags for each remote control valve with valve number.

9. VALVE BOXES

- A. Valve boxes shall be installed in shrub areas whenever possible.
- B. Each valve box shall be installed on a foundation of 3/4 inch gravel backfill, 3 cubic feet minimum. Valve boxes shall be installed with their tops 1/2 inch above the surface of surrounding finish grade in lawn areas and 2 inches above finish grade in ground cover areas.

10. IRRIGATION HEADS AND INLINE DRIP TUBING

- A. Irrigation heads and inline drip tubing shall be installed as indicated on the drawings.
- B. Spacing of heads and inline drip tubing shall not exceed maximum indicated on the drawings.
- C. Riser nipples shall be of the same size as the riser opening in the sprinkler body.

11. BACKFLOW PREVENTION UNITS

- A. Backflow Prevention Units shall be existing as indicated on the drawings. The existing backflow prevention unit shall be installed in accordance with the requirements set forth by local codes.
- B. The exact location of the existing backflow device shall be field verified with the Landscape Architect or owner's authorized representative before installation.
- C. The contractor shall be responsible for the testing and certification of the existing backflow device for proper operation. Testing and certification shall be performed by a state qualified backflow tester.

12. MISCELLANEOUS EQUIPMENT

- A. Install all assemblies specified herein according to the respective detail drawings or specifications, using best standard practices.
- B. Quick coupler valves shall be set approximately 18 inches from walks, curbs, header boards, or paved areas where applicable.
- C. Install devices such as rain sensors, freeze sensors, flush valves, and air relief valves, master valves and flow sensors as indicated on the drawings and as recommended by the manufacturer.

13. FLUSHING THE SYSTEM

- A. Prior to installation of irrigation heads, the valves shall be opened and a full head of water used to flush out the lines and risers.
- B. Irrigation heads shall be installed after flushing the system has been completed.

14. ADJUSTING THE SYSTEM

- A. Contractor shall adjust valves, align heads, and check the coverage of each system prior to coverage test.
- B. If it is determined by the Landscape Architect or **Architect**'s authorized representative that additional adjustments or nozzle changes will be required to provide proper coverage, all necessary changes or adjustments shall be made prior to any planting.
- C. The entire system shall be operating properly before any planting operations commence.
- D. Automatic control valves are to be adjusted so that the irrigation heads, **drip emitters and inline drip tubing** operate at the pressure recommended by the manufacturer.

15. TESTING AND OBSERVATION

- A. Do not allow or cause any of the work of this section to be covered up or enclosed until it has been observed, tested and accepted by the Landscape Architect, **Architect**, and governing agencies.
- B. The Contractor shall be solely responsible for notifying the Landscape Architect, **Architect**, and governing agencies, a minimum of 48 hours in advance, where and when the work is ready for testing.
- C. When the sprinkler system is completed, the Contractor shall perform a coverage test of each system in its entirety to determine if the water coverage for the planted areas is complete and adequate in the presence of the Landscape Architect.
- D. The Contractor shall furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from the plans, or where the system has been

willfully installed as indicated on the drawings when it is obviously inadequate, without bringing this to the attention of the Landscape Architect. This test shall be accepted by the Landscape Architect and accomplished before starting any planting.

- E. Areas to be maintained for the formal maintenance period shall start maintenance at the same time, as directed by the Landscape Architect, **Architect**, and governing agencies. Partial areas will not be released into maintenance prior to completion of items listed in the pre-maintenance review. The maintenance period may not be phased.
- F. If, after the maintenance review, the irrigation systems are not accepted by the Landscape Architect, the contractor shall reimburse the Architect for additional site visits, or additional time required to review work. All additional time will be billed at the Architect's hourly rate and will be paid for by the contractor at no additional cost to the Architect.
- G. Final inspection will not commence without record drawings as prepared by the Irrigation Contractor.

16. MAINTENANCE

- A. During the maintenance period the Contractor shall adjust and maintain the irrigation system in a fully operational condition providing complete irrigation coverage to all intended plantings.

17. COMPLETION CLEANING

- A. Clean up shall be made as each portion of the work progresses. Refuse and excess dirt shall be removed from the site, all walks and paving shall be swept, and any damage sustained on the work of others shall be repaired to original conditions.

END OF SECTION

SECTION 329113 – SOIL PREPARATION

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete and thorough preparation of the planting soil, including soil amendment products, imported topsoil, as required, to make up deficiencies in quantity of soil available on site, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Agronomic Soil Fertility Testing and Soil Percolation Testing.
 - 2. Topsoil.
 - 3. Pre-Plant Weed Control.
 - 4. Soil Conditioners, Amendments and Fertilizers (Organic & Chemical).
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 312219 – Landscape Grading.
 - 2. Section 321513 – Decomposed Granite Paving.
 - 3. Section 322800 – Irrigation Systems.
 - 4. Section 329200 – Lawns and Grasses.
 - 5. Section 329300 – Exterior Plants.
 - 6. Section 329400 – Landscape Planting Accessories.
 - 7. Section 329813 – Landscape Establishment Period.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. USDA – United States Department of Agriculture.
 - 2. ASTM – American Society for Testing & Materials.
- B. Definitions:
 - 1. *Topsoil* - Shall be friable soil, providing sufficient structure in order to give good tilth and aeration to the soil. Topsoil shall be free of roots, clods, stones larger than one-inch (1”) in the greatest dimension, pockets of coarse sand, noxious weeds, sticks, lumber, brush and other litter. It shall not be infested with nematodes or other undesirable disease-causing organisms such as insects and plant pathogens.
 - 2. *Gradation Limits* - Soil shall be a sandy loam, loam, clay loam or clay. The definition of soil texture shall be per the USDA classification scheme. Gravel over ¼-inch in diameter shall be less than 20% by weight.
 - 3. *Permeability Rate* - Hydraulic conductivity rate shall be not less than one-inch (1”) per hour, nor more than twenty-inches (20”) per hour, when tested in accordance with the USDA Handbook Number 60, Method 34b, or other approved Methods.
 - 4. *Fertility* - The range of the essential elemental concentration in soil shall be as follows:

<u>Ammonium Bicarbonate/ DTPA Extraction (PPM)</u>		
Element	Concentration of elements for Soil Selection, measured as mg/kilogram dry weight basis	Concentration of Elements for Final Acceptance (amended and conditioned soil) measured as mg/kilogram dry weight basis
Phosphorous	2 - 40	10 - 40
Potassium	40 - 220	100 - 220
Iron	2 - 35	24 - 35
Manganese	0.3 - 6	0.6 - 6
Zinc	0.6 - 8	1 - 8
Copper	0.1 - 5	0.3 - 5
Boron	0.2 - 1	0.2 - 1
Magnesium	50 - 150	50 - 150
Sodium	0 - 100	0 - 100
Sulfur	25 - 500	25 - 500
Molybdenum	0.1 - 2	0.1 - 2

5. *Acidity* - The soil pH range measured in the saturation extract (Method 21a, USDA Handbook Number 60) shall be 6.0 – 7.9.
6. *Salinity* - The salinity range measured in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 0.5 – 2.0 dS/m. If calcium and if sulfate ions both exceed 20 milliequivalents per liter in the saturation extract, the maximum salinity shall be 4.0 dS/m.
7. *Chloride* - The maximum concentration of soluble chloride in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 150 mg/l (parts per million).
8. *Boron* - The maximum concentration of soluble boron in the saturation extract (Method 3a, USDA Handbook Number 60) shall be 1 mg/l (parts per million).
9. *Sodium Adsorption Ratio (SAR)* - The maximum SAR shall be 3 measured per Method 20b, USDA Handbook Number 60.
10. *Aluminum* – Available aluminum measured with the Ammonium Bicarbonate/DTPA Extraction shall be less than 3.0 parts per million.
11. *Soil Organic Matter Content* - Sufficient soil organic matter shall be present to impart good physical soil properties but not be excessive to cause toxicity or cause excessive reduction in the volume of soil due to decomposition of organic matter. The desirable range is 3% to 5%. The carbon:nitrogen ratio should be about 10. A high carbon:nitrogen ratio can indicate the presence of hydrocarbons or non-humified organic matter.
12. *Calcium Carbonate Content* - Free calcium carbonate (limestone) shall not be present in acid-loving plants.
13. *Heavy Metals* - The maximum permissible elemental concentration in the soil shall not exceed the following concentrations:

<u>Ammonium Bicarbonate/DTPA Extraction (PPM)</u>	
<i>Element</i>	<i>(mg/kilogram) dry weight basis</i>
Arsenic	1
Cadmium	1
Chromium	10
Cobalt	2
Lead	30
Mercury	1
Nickel	6
Selenium	3
Silver	.5
Vanadium	3

- a. If the soil pH is between 6 and 7, the maximum permissible elemental concentration shall be reduced 50% to the above values. If the soil pH is less than 6.0, the maximum permissible elemental concentration shall be reduced 75% of the above values. No more than three (3) metals shall be present at 50% or more of the above values.
 14. *Phytotoxic constituent, herbicides, hydrocarbons, etc.* – Germination and growth of plants shall not be restricted more than 10% compared to the reference soil. Total petroleum hydrocarbons shall not exceed 50 mg/kg dry soil measured per the modified EPA Method No. 8015. Total aromatic volatile organic hydrocarbons (benzene, toluene, xylene and ethylbenzene) shall not exceed 0.5 mg/kg dry soil measured per EPA Method No. 8020.
 15. *Sub Grade* - Soil level resulting from the rough grading work under another Section. Cultivation of sub grade areas prior to placement of Topsoil is included in this Section.
 16. *Stockpiled Topsoil* - Soil stockpiled for spreading over prepared sub-grade.
 17. *Stockpiled Native Topsoil* - Topsoil stripped from the site prior to rough grading Work (under another Section), to be spread and amended as Work under this Section.
 18. *Imported Topsoil* - Off-site Topsoil, imported and stockpiled under this Section, to be spread and amended as Work under this Section.
- C. Measurements:
1. PPM: Measurement, in parts per million.
3. SUBMITTALS
- A. General:
1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.

2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
1. Product/Material Data. Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
 - a. Planting Soil (Imported/Amended Topsoil).
 - b. Soil Amendments (for each type used, for Sand, Perlite, Peat Humus, Gypsum, Soil Sulfur, Iron, etc).
 - c. Bulk Composted Organic Soil Amendment Material.
 - d. Granular Soil Conditioning Material.
 - e. Mycorrhizal Inoculum.
 - f. Fertilizers (for each type used).
 2. Agronomic Soil Fertility Analysis and Recommendations: Submit a minimum of fourteen (14) days prior to amending of the soil and ordering soil amendments. The locations of where each of the soil test samples were derived from the Project Site shall be keyed to the site plan and shall be included with the results.
 3. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar installations.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
1. Provide Material Sample sets for each item submitted under Product/Material Data.
- D. Submittals under this Article will be rejected without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if the required information is missing or not presented in the format as requested.
- E. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.
4. QUALITY ASSURANCE AND CONTROL
- A. Installer Qualifications for requirements indicated herein this Section:
1. Licensed Landscape Contractor, C-27, in the State of California.
 - a. Engage an experienced, licensed Contractor who has completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.

- b. **Installer's Field Supervision:** Contractor shall maintain an experienced, full-time landscape supervisor/superintendent at the Project Site during times that landscaping operations identified herein the Contract are in progress.
- B. **Manufacturer's Directions:** Follow Manufacturer's directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings or Contract Specifications.
- C. **Permits, Fees, Bonds, Testing, and Inspections:** Contractor shall arrange and pay for permits, fees, bonds, testing, and inspections necessary to perform and complete his portion of the Work.
- D. **Approved Testing Laboratory and Procedures for Agronomic Soil Fertility Analyses:**
 - 1. Agronomic Soil Fertility Analyses shall be conducted by a reputable, certified, agronomic soils laboratory. Laboratory shall be a member of the Council on Soil Testing and Plant Analysis. The same laboratory shall be used throughout the duration of the Contract:
 - a. Wallace Laboratories, El Segundo, CA. 310-615-0116.
 - b. Soil and Plant Laboratory, Orange, CA. 714-282-8777.
 - c. Fruit Growers Laboratory, Santa Paula, CA. 805-659-0910.
 - 2. Contractor shall verify and confirm the selected Testing Laboratory and specific location(s) of soil sample(s) with the Landscape Architect prior to commencing soil sampling operations.
 - 3. For each Soil type, submit the physical Soil Samples directly to the selected Laboratory for analysis, per the procedures outlined per Part III herein this Section.
 - a. In addition to the physical Soil Samples, Contractor shall also provide the Laboratory with a copy of the Soil Amendment and Fertilizer products indicated herein this Section.
 - 4. Along with the testing data results, the Agronomic Soil Fertility Analysis shall also include written recommendations authored by the Laboratory conducting the Analyses for amending, treating, and/or correcting the sampled soils. Laboratory shall utilize the organic-based Soil Amendments and Fertilizers described herein this Section to the greatest extent possible to produce satisfactory planting soil(s) suitable for sustaining healthy viable plant growth.
 - a. The Analyses shall also include Maintenance and Post-Maintenance fertilization programs for planted areas within the Contract.
 - 5. Agronomic Soil Fertility Analyses shall be performed on each Soil Type samples, and include testing results for the following:

pH;
Electro-conductivity (salinity) measurement – saturated extract.
Measurement of sodicity (Sodium Absorption Ratio);
Estimate of soil texture and soil organic matter;
Presence of lime;
Nutrients/Toxic Elements measurement of DPTA extract
Saturation extracts for nitrate, sulfate, sodium, calcium, magnesium, potassium, soluble phosphate, and boron;
Parasitic nematodes;

Herbicide contamination;
(For Lightweight Soil Mixes): Test for physical and chemical composition, and saturated weight per cu.ft.

6. Planting operations shall not commence until the results of the Agronomic Soil Fertility Analysis and Recommendations are reviewed accordingly by the Landscape Architect.
7. The quantity or type of amendments may be modified by the Landscape Architect within fourteen (14) days of receipt of the results. The Agronomic Soil Fertility Analysis and Recommendations shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.
8. The Agronomic Soil Fertility Report/Recommendation shall take precedence over the amendment and fertilizer application rates specified herein or on the Contract Documents.

5. DELIVERY, STORAGE, AND HANDLING

- A. General: Deliver and install materials so as to not delay Work, and install only after preparations for installation have been completed.
 1. Packaged Materials: Deliver packaged materials in original, unopened packages or containers, with manufacturer's labels intact and legible, showing weight, analysis, and name of manufacturer. Store and secure properly to prevent theft or damage.
 - a. Store packaged materials off ground and under cover, away from damp surfaces and inclement weather.
 - b. Protect during storage and construction against soilage or contamination from earth and other materials.
 2. Bulk Materials:
 - a. Deliver and store bulk materials so as not to impede Work of others.
 - b. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas, or plants.
 - c. Protect during storage and construction against soilage or contamination from earth and other materials. Provide adequate separation between bulk materials so as not to cross-contaminate bulk materials.
 - d. Store under cover, away from inclement weather.
 - e. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water run-off, and airborne dust reaching adjacent properties, water conveyance systems, structures, or walkways.
 - f. Accompany each delivery of bulk materials (fertilizers, amendments, topsoil, etc.) with appropriate certificates. Furnish original certificates to Landscape Architect upon request.

6. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.

- C. Excavation: When conditions detrimental to adequate Soil Preparation operations are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease operations and notify Landscape Architect for further direction.
- D. Installation: Perform Soil Preparation operations only when weather and soil conditions are suitable in accordance with locally accepted practices.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected materials immediately from Project site. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. SITE CONDITIONS

- A. Project Site shall be free of weeds, native grasses, evasive grasses, (Bermuda Grass, Nut Grass, Kikuyu Grass, etc.) prior to Topsoil distribution or soil amendment placement.
- B. Excessive rock, dead or declining vegetation, trash, debris, or other items that has accumulated throughout the duration of the Project shall be removed from the Project Site by the Contractor, and as directed by the Landscape Architect.
- C. Grading and soil preparation Work shall be performed only during the period when beneficial and optimum horticultural results may be obtained. If the moisture content of the soil should reach such a level that working it would destroy soil structure or cause compaction, spreading and grading operations shall be suspended until, in the opinion of the Landscape Architect, the moisture content is increased or reduced to acceptable levels and the desired results are likely to be obtained.
 - 1. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect.
 - 2. If the soil moisture level is found to be insufficient for planting, planting pits shall be filled with water and allowed to drain before commencing planting operations.
- D. Planting areas which become compacted in excess of 85% relative compaction due to construction activities shall be tilled and thoroughly cross-ripped to a minimum depth of twelve-inches (12") to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.

8. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.

- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. PLANTING SOIL (TOPSOIL)

- A. Topsoil: Meet ASTM D5268, pH range of 5.5 to 7, 4 percent organic material minimum.
 - 1. Topsoil Source: Reuse native surface soil stockpiled on the site. Verify suitability of native surface soil stockpiled on site to produce Topsoil meeting requirements; amend as necessary. Supplement native surface soil stockpiled on site with imported Topsoil when quantities are insufficient.
 - a. Composition: Fertile, friable, well-drained soil, of uniform quality, free of stones over one-inch (1") diameter or larger in any dimension sticks, oils, chemicals, plaster, concrete, roots, plants, sod, and other deleterious or extraneous materials harmful to plant growth.
 - b. Obtain an Agronomic Soil Fertility Report/Recommendation of the stockpiled Topsoil from the approved Testing Laboratory indicated herein this Section.
 - c. Test Results: Request Testing Agency to send one (1) copy of test results direct to the Landscape Architect and one (1) copy to the Owner. Amend as required.
 - 2. Topsoil Source: Provide Imported Topsoil obtained from off-site sources, from naturally well-drained sites; do not obtain from bogs or marshes.
 - a. Quantity: Provide Imported Topsoil as soon as an insufficient quantity of native stockpiled surface soil is verified. Quantity of Imported Topsoil to complete the Work shall be calculated by Contractor.
 - b. Stockpiling: Stockpile on site as directed by Owner.
 - c. Composition: To match in quality, accepted native stockpiled Topsoil.
 - d. Analysis: Obtain an Agronomic Soil Fertility Report/Recommendation of the Imported Topsoil from the approved Testing Laboratory indicated herein this Section.
 - e. Review: Landscape Architect reserves the right to take samples of the Imported Topsoil delivered to the site for conformance to the Contract Specifications.
 - f. Rejected Imported Topsoil: Immediately remove rejected Imported Topsoil off site, at Contractor's expense.

2. SOIL MIXES/BLENDS

- A. Soil Conditioner Blend, for amending on-site native soils or imported topsoil: Furnish a thoroughly blended composition of Bulk Composted Organic Soil Amendment Material and Granular Soil Conditioning Material & Fertilizer. Any substitution for the "Soil Conditioner Blend" listed herein must be requested by the Contractor and approved, in writing, by the Landscape Architect at least thirty (30) days prior to installation.
 - 1. Bulk Composted Organic Soil Amendment Material:

- a. **Material Composition:** Bulk Composted Organic Soil Amendment Material shall be produced from a composted, nitrolized blend of wood shavings, forest products, and/or rice hulls,. Upon completion of the composting process, the Material shall be thoroughly cured for a minimum of 100 days, and shall be free from any trash (glass, metal, plastic, etc.) deleterious materials, bio-solids, and/or toxic chemicals. The Material shall be non-hazardous, and conform to US Environmental Protection Agency 40 CFR503 criteria for “Class A” products. It shall also exceed standards and specifications for unrestricted application as a landscaping and agricultural soil amendment.

- 1) **Gradation/Screen Analysis:** A minimum of 90% of the material by weight shall pass a ½” screen. Material passing the screen shall meet the following criteria:

<u>Percent Passing</u>	<u>Sieve Designation</u>
85 - 100%	9.51 mm (3/8”)
50 – 80%	2.38 mm (No. 8)
0 – 40%	500 micron (No. 35)

- 2) **Maturity:** Physical characteristics suggestive of maturity include shall include:

- Color: Dark brown to black.
- Odor: Aerobic, without malodorous presence of decomposition products.
- Particle characterization: Identifiable wood pieces are acceptable but the balance of Material should be soil-like without recognizable grass or leaves.

- b. **Analytical Properties:** Contractor shall submit proof of the Bulk Composted Organic Soil Amendment Material by providing a sample as identified herein this Section, and a lab analysis that has been performed within 30 days of the installation of the planting. Soil mix shall have (at a minimum) the following properties:

<u>Material</u>	<u>Minimum Targeted Property/Range</u>
Total Nitrogen (N%)	.50-1.0%
Phosphorus (as P2O5)	2.0%
Potassium (as K2O)	0.2%
pH (units)	6.0 to 7.5, as determined in saturated paste.
Organic Content	Minimum 50% based on dry weight and determined by ash method. Minimum 205 lbs. organic matter per cubic yard of compost.
ECe (millimho/cm)	<5.0; based on pre-leaching with equal volume of water.

Carbon-to-Nitrogen Ratio	<20-to-1, nitrogen stabilized.
Bulk Density	1,000 to 1,100 pounds/cubic yard.
Sodium Absorption Ratio (SAR)	Under 20.0
Total Iron	1.5%3.
Moisture Content	35%-60%
Acid-soluable Ash content	No less than 6% and no greater than 20%.
Salt Content	<10millimho/cm @ 25d C. on a saturated paste extract.
Boron Content	<1.0 parts per million on a saturated paste extract.
Silicon-Content (acid-insoluable ash)	<50%
Calcium Carbonate	No presence on alkaline soils.
Maximum Total Permissible Pollutant Concentrations (in PPM on a dry-weight basis)	<ul style="list-style-type: none"> • Arsenic: 20 • Cadmium: 15 • Chromium: 300 • Cobalt: 50 • Copper: 150 • Lead: 200 • Mercury: 10 • Molybdenum: 20 • Nickel: 100 • Selenium: 50 • Silver: 10 • Vanadium: 500 • Zinc: 300

- c. Application Rate: As indicated herein this Section under "Planting Soil Amendments Schedule".
- d. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Soil Conditioner*, Synagro Professional Organic Soil Products.
 - 2) *Agromend*, Agromin Horticultural Products.
 - 3) *Humic Compost 1/2"*, Greenway Compost.
 - 4) *Superior Blend Compost*, Artesia Sawdust Products, Inc.
 - 5) *Compost*, EarthWorks Soil Amendments, Inc.
 - 6) *Contractor's Blend*, Recycled Wood Products (RWP).
 - 7) *#SSA-CST Supreme Organic Soil Amendment*, Plants Choice, Inc.
 - 8) *Humic Compost 3/8"*, Agri Service, Inc.
 - 9) Or equal, as approved by the Landscape Architect.
2. Granular Soil Conditioning Material & Fertilizer:
 - a. Material Composition and Analytical Properties: Granular Soil Conditioning Material & Fertilizer shall be a singular manufacturer-blended combination of soil conditioning material and fertilizer. It shall be granular in form, long-lasting, free flowing, and suitable for application with approved equipment. It shall not contain

any sewage sludge or manure-based products, and shall contain the following guaranteed minimum available analysis range:

<u>Element/Material</u>	<u>Targeted Property Range</u>
Nitrogen (N)	5.0% to 6.0%
Phosphoric Acid (as P2O5)	2.0% to 3.0%
Potash (as K2O)	1.0% to 4.0%
Humic Acids	15.0 % to 20.0%
Calcium	7.0%
Sulfur	0.0% to 5.0%

- b. Commercial-Grade Products, Manufacturers and Associated Rates of Application: Subject to compliance with requirements, provide products by one (1) of the following:
- 1) *Tri-C 6-2-4*, Tri-C Enterprises LLC, Chino, CA. 800-927-3311.
 - a) Application Rate at 70 lbs. per 1,000 square feet of planting area.
 - 2) *Gro-Power Plus 5-3-1*, Gro-Power, Chino, CA. 909-393-3744.
 - a) Application Rate at 200 lbs. per 1,000 square feet of planting area.
 - 3) or equal, as approved by the Landscape Architect.

3. ORGANIC SOIL AMENDMENT COMPONENTS

- A. Washed Plaster Sand: Clean, washed, natural or manufactured sand, sharp, fine-textured, free of toxic materials. Sieve tested in accordance with ASTM C136, with 100% passing through a #4 screen, 0% passing through a #200 screen.
1. Chemical Properties: (by DPTA Saturation Extract Method):
 - a. Soluble Salts/Salinity: Maximum conductivity of 3.0 millimhos/cm at 25 degrees C.
 - b. Boron: Maximum concentration of 1.0 PPM.
 - c. Sodium Absorption Ratio (SAR): Maximum 6.0.
 - d. pH: 7.0.
- B. Perlite: Horticultural Perlite, soil amendment grade, 6.5 to 7.5 pH.
1. Unacceptable Materials: Polystyrene beads shall not be used as a substitution for horticultural Perlite.
- C. Vermiculite: Horticultural Vermiculite, gold-brown in color.
1. Size: 2-4mm, 5 mesh to 10 mesh sieve size.
 2. Density: 4.5 to 5.5 lb./cuft.
 3. Grade: #2, Medium Grade.
- D. Peat Humus:
1. Type: Canadian Sphagnum Peat, as derived from the genus Sphagnum, medium-divided, coarse fibrous texture, brown in color.
 2. Measurement: Measure peat in air dry condition, containing not more than 35% moisture by weight on an "as-received" basis.
 3. Physical Properties:

<u>Percent Passing</u>	<u>Sieve Size</u>
95 - 100%	9.51 mm (3/8 in.)
0 - 40%	500 micron (#35, 32 mesh)

4. Organic Content (dry weight basis): Minimum 95%.
5. Fiber Content: Greater than 66%.
6. Water Holding Capacity: 20x to 30x its dry weight in water.
7. Range in Ash Content (%): 1.0 to 5.0.
8. Chemical Properties:
 - a. Nitrogen (dry weight basis): 0.6-3.0%.
 - b. Salinity/Soluble Salts: Saturation extract conductivity 0.0-3.0 millimhos/cm @ 25 degrees C.
 - c. pH range: 3.0 to 4.0.
9. Unacceptable Materials:
 - a. Coir Dust.
 - b. Sedge Peat.
 - c. Reed Peat.
 - d. Hypnum Peat.

E. Mycorrhizal Inoculum:

1. Mycorrhizal Inoculum for Plant Material (not Palm Trees): Dual soil-conditioning biological inoculum system of endo-and ecto- Mycorrhizal, used to further aid the plants ability to efficiently uptake available soil nutrients and increase resistance to drought.
 - a. Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) 7-gram *Myco-Pak*, Tri-C Enterprises LLC, Chino, CA, 800-927-3311.
 - 2) 4 oz. *Packet - Roots 1 Step*, Roots, Inc., Independence, MO, 800-342-6173.
 - 3) Or equal, as approved by the Landscape Architect.
 - b. Provide at the prescribed application rate, per the Manufacturer's written recommendations.

4. CHEMICAL SOIL AMENDMENT COMPONENTS

- A. General: Chemical Soil Amendment Components listed herein may or may not be used, depending on the results of the Agronomic Soil Fertility Report. Provide as required:
- B. Gypsum: Commercially-processed and packaged agricultural-grade hydrated calcium sulfate product (CaSO₄), 92.0% minimum, pH at 7.1.
 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Ben Franklin® No. 1 Agricultural Gypsum*, U.S. Gypsum Company.
 - b. *100% Good Stuff Gypsum™*, Art Wilson Company.
 - c. *CAL-SUL® Pelletized Agricultural Gypsum*, North Pacific Group.
 - d. *Bumper Harvest Agricultural Gypsum*, Domtar Gypsum.
 - e. *Premium 97 Solution-Grade Gypsum*, Diamond K, Inc.
 - f. Or equal, as approved by the Landscape Architect.

- C. Soil Sulfur: Elemental Sulfur (90% min.) commercially manufactured, water degradable, palletized.
 - 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Disper-Sul*, Martin Resources, Inc.
 - b. *Soil Sulfur*, Red Top.
 - c. Or equal, as approved by the Landscape Architect.
 - D. Iron: Non-staining, 40% Fe minimum, complete with micro-nutrients and 2% humic acids, as derived from iron oxide, manganese oxide, or zinc oxide.
 - 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Gro-Power Iron*, Gro-Power, Chino, CA.
 - b. *Iron 45 w/ Micronutrients*, Tri-C Enterprises LLC, Chino, CA.
 - c. Or equal, as approved by the Landscape Architect.
 - E. Dolomite Lime: Agricultural-grade mineral soil conditioner containing 35% minimum magnesium carbonate, and 49% minimum calcium carbonate, 100% passing #65 sieve.
 - F. Potassium Sulfate (Sulfate of Potash K₂O), (0-0-50 guaranteed analysis N-P₂O₅-K₂O): Agricultural-grade, containing minimum 50% of water-soluble potash and 18% Sulfur (S).
 - G. Single Superphosphate P₂O₅ (0-15-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product, containing 15% available phosphoric acid and 14% Sulfur.
 - H. Triple Superphosphate P₂O₅, (0-45-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product, containing 45% available phosphate and 15% Calcium (Ca).
 - I. Ammonium Sulfate (NH₄)₂SO₄, (21-0-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product containing approximately 21% ammonia.
 - J. Ammonium Nitrate NH₄NO₃, (34-0-0 guaranteed analysis N-P₂O₅-K₂O): Commercial product containing approximately 34% ammonia.
 - K. Calcium Nitrate CaNO₃, (15.5-0-0 guaranteed analysis N-P₂O₅-K₂O): Agricultural grade containing 15-1/2% nitrogen.
 - L. Potassium Nitrate KNO₃, (13-0-45 guaranteed analysis N-P₂O₅-K₂O): Commercial product containing approximately 13% nitrogen and 45% potassium.
 - M. Ureaformaldehyde (38-0-0 guaranteed analysis N-P₂O₅-K₂O): Granular commercial product containing approximately 38% nitrogen.
 - N. Urea CO(NH₂)₂, (46-0-0 guaranteed analysis N-P₂O₅-K₂O): Granular commercial product containing 46% nitrogen.
 - O. I.B.D.U. (Iso Butyl diene Diurea): Commercial product containing 31% nitrogen.
5. FERTILIZERS
- A. Composition: Nitrogen (N), phosphorous (P₂O₅), and potassium (K₂O) content, plus other elements, as indicated.

- C. Turf Grass Starter Fertilizer (pre-plant 3-12-12), as required
1. General: Shall be applied for turf grasses planted from sod or seed (not hydroseed or hydrostolons).
 2. Fertilizer shall be an organic-based, long-lasting, controlled-release, uniform in composition, free flowing granular-type fertilizer with micronutrients, suitable for application with approved equipment. Fertilizer shall be high in potassium and phosphorous elements to aid in strong root development.
 - a. Turf/Lawn Fertilizer shall contain the following minimum available percentages by weight of plant food (pending results of soil analysis):

<u>Element/Material</u>	<u>Targeted Property Range</u>
Nitrogen (N) Slow Release	3.0% minimum
Phosphoric acid (as P2O5)	12.0% minimum
Potash (as K2O)	12.0% minimum
Humus	35.0% minimum
Humic Acids w/ micronutrients and soil enhancers	7.0% minimum

3. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Gro-Power 3-12-12 Flower & Bloom*, Gro-Power, Chino, CA. 909-393-3744.
 - b. Or equal, as approved by the Landscape Architect.
4. Application Rate: Twenty (20) pounds per 1,000 SF.

E. Fertilizer Tablet:

1. General: Fertilizer Tablet shall be a 7-gram tablet, organic-based, tightly compressed chip-type commercial grade, 12-month slow-release planting tablets, and shall be composed of the following available percentages by weight of plant food:

<u>Element/Material</u>	<u>Targeted Property Range</u>
Nitrogen (N)	12.0% minimum
Phosphoric acid (as P2O5)	8.0% minimum
Potash (as K2O)	8.0% minimum
Humus	20.0% minimum

Humic Acids w/ micronutrients and soil enhancers	4.0% minimum
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2. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Gro-Power 12-8-8 Planting Tablets*, Gro-Power, Chino, CA 909-393-3744.
 - 1) Application Rate: As indicated herein Part III this Section.
 - b. Or equal, as approved by the Landscape Architect.

6. ACCESSORIES

- A. Wetting Agent/Water Storing Polymer: Non-biodegradable, granular, polyacrylamide polymer soil amendment.
 1. Commercial-Grade Products & Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Broadleaf P4*, Broadleaf Industries, Inc. Chula Vista, CA 619-424-7880.
 - b. Or equal, as approved by the Landscape Architect.
- B. Perforated Drain Pipe & Drain Sock (Tree Chimney): Refer to Section 329400 – Landscape Planting Accessories.
- C. Landscape Mulch Material:
 1. Organic Wood Mulch: Refer to Section 329400 – Landscape Planting Accessories.
 2. Crushed Aggregate: see Contract Documents

3.EXECUTION

1. AGRONOMIC SOIL FERTILITY REPORT/RECOMMENDATION

- A. General: Agronomic Soil Fertility Testing shall be under the management and direction of the Owner and/or Landscape Architect.
- B. Agronomic Soil Fertility Testing Bid Allowance: Contractor shall provide a Bid Allowance within the Contract price from which all Agronomic Soil Fertility Testing for the Project shall be performed:
- C. Contractor shall not be entitled to any fee, payment, stipend, grant, mark-up, or any other financial gain or incentive for any Work performed under the Agronomic Soil Fertility Testing Bid Allowance.
 1. At the direction of the Owner and/or Landscape Architect, Contractor shall be responsible to provide payment(s) to the Agronomic Soil Testing Laboratory for Work under the Agronomic Soil Fertility.
 2. Testing Bid Allowance. Each payment made on the Laboratory's invoice shall be paid in full and within a timely fashion not to exceed thirty (30) days from the date of the invoice, as to not delay any Work under the Contract.
 3. At the completion of Work indicated herein this Article, the Contractor shall provide legible photocopies of all invoices and payments made to the Agronomic Soil Testing Laboratory, under the Agronomic Soil Fertility Testing Bid Allowance, to the Owner and/

or Landscape Architect. All money remaining in the Allowance shall be refunded to the Owner as a condition of Final Acceptance of Work.

D. Procedures:

1. Owner and/or Landscape Architect shall be responsible to retain a reputable and certified Agronomic Soils Testing Laboratory for Work under the Contract. The selected Laboratory shall also be a member of the Council on Soil Testing and Plant Analysis:
 - a. Wallace Laboratories, El Segundo, CA, phone 310-615-0116.
 - b. Soil and Plant Laboratory, Orange, CA, phone 714-282-8777.
 - c. Fruit Growers Laboratory, Santa Paula, CA, phone 805-659-0910.
2. Upon the direction of the Owner and/or Landscape Architect, the Agronomic Soils Testing Laboratory shall provide Standard Agricultural Suitability Analyses and other Specific Soil Tests.
 - a. Contractor shall notify the Owner and Landscape Architect, in writing, of the Work schedule for the stages of Work indicated herein this Article. The Agronomic Soils Testing Laboratory shall be provided access to the Project Site to gather soil samples, as required, to perform the ensuing Laboratory tests. Soil samples shall be gathered from representative locations throughout the Project Site, by qualified Laboratory personnel, during the following stages of Work:
 - 1) Prior to Rough Grading Operations.
 - 2) During Rough Grading Operations.
 - 3) Post Rough Grading Operations, and prior to the establishment of Finished Grades and the application of topsoil, soil amendments, and/or fertilizers).
 - 4) Post Finished Grading Operations, and prior to Planting Operations.
 - 5) During Planting Operations, including Soil Excavation, Planting, and Soil Backfill.
 - 6) After Planting Operations and prior to preparation of the Punch List.
 - 7) After halfway completion of the Contracted Landscape Establishment Period.
 - b. The Agronomic Soils Testing Laboratory shall provide the Owner, Landscape Architect, and Contractor with the results of all Soil Testing Analyses performed during each respective stage of Work as indicated herein this Article. The Analyses shall include the soil chemical compositions and recommendations to remedy the soil. The recommendations shall include provisions for using soil amendments and fertilizers indicated herein this Section.

2. SOIL PERCOLATION TESTING

- A. Type/Quantity: During operations of Agronomic Soil Fertility Testing and prior to installing Plant Material, Contractor shall perform Soil Percolation Tests, through the direction of the Landscape Architect, in selected representative areas of the Project Site, to verify acceptable natural drainage, soil structure, and soil composition. Contractor shall verify the locations of the Soil Percolation Tests with the Landscape Architect.
 1. Required Number of Soil Percolation Tests: 4
- B. Procedure: Each Soil Percolation Test shall be performed as follows:
 1. Dig a hole: 2'-0" wide x 2'-0" long x 2'-0" deep.
 2. Fill the hole with water to top and cover with plywood and barricade. Allow hole to drain and fill again to top.
 3. Make daily observations, noting the depth of water each day.
 4. Report findings, in writing, to the Landscape Architect. Include the length of time the water takes to drain completely from each hole, date of test, location, and other information, which may be useful in providing further recommendations.

- C. Results: Based on the combined results of the Agronomic Soil Fertility Testing and the Soil Percolation Tests, Contractor may be required to install additional tree drainage sumps or other drainage methods at each planting pit for trees larger than 15-gallon container stock. This does not relieve the Contractor's obligation within the Base Bid to provide the required Tree Root Aeration Units indicated in Section 329400 – Landscape Planting Accessories. Contractor shall include, as a line-item price within the Base Bid, the price per each additional tree drainage sump, should they be required (based on the testing). Should additional tree drainage sumps or other methods is required, compensation shall be awarded to the Contractor at the line-item price (each) as provided by the Contractor.

3. SOIL MOISTURE CONTENT

- A. General: Do not work soil when moisture content is so great that excessive compaction occurs, or when it is so dry that dust will form in air, or that clods will not break readily. Apply water, if necessary, to bring soil to an optimum moisture content for tilling and planting. Soil moisture level prior to planting shall be no less than 75% of field capacity. The determination of adequate soil moisture for planting shall be the judgment of the Landscape Architect. Range: Maintain within two-percent (2%) above or below optimum moisture content at times during Work.

4. SITE CONDITIONS

- A. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and contracted Landscape Establishment Period.
- B. Protect concrete paving, headers, and drainage from staining due to contact with wet nitrogen stabilized mulch/sawdust, or contact with chelated iron. Correct any stained concrete.

5. CLEARING & CULTIVATION

- A. Clearing: Clear planting areas free of stones two-inches (2") in diameter and larger, weeds, debris, and other extraneous materials prior to soil preparation Work.
- B. Pre-Plant Weed Control:
 - 1. Clear and remove existing weeds by spraying and grubbing to at least one-inch (1") below the soil surface.
 - 2. Dead weeds shall be cleared and removed prior to planting.
 - 3. Maintain a weed-free Project Site until final acceptance by the Owner, utilizing mechanical, chemical, or manual treatment.
- C. Cultivation of Native Site Soil and/or Spreading Imported Topsoil, with Amendments/Fertilizers:
 - 1. Verification: In planting areas where Imported Topsoil will be applied, verify that sub-grades prior to installation of Imported Topsoil have been established under rough grading. Do not spread Imported Topsoil prior to acceptance of sub-grade Work.
 - 2. Cultivation: Following Pre-Plant Weed Control operations, rip or cultivate verified planting areas of Native Site Soil at the indicated depth, prior to applying Imported Topsoil (if required) and Soil Amendments/Fertilizers.
 - a. Depth of Cultivation: minimum Ten-inches (10").

3. Following initial cultivation of existing Native Site Soil, evenly spread Imported Topsoil (if required) throughout all planting areas at the minimum indicated depth to meet finished landscape grades.
 - a. Depth of Imported Topsoil: Minimum six-inches (6").
4. Once Imported Topsoil has been spread, uniformly broadcast all required Soil Amendments and Fertilizers indicated in Planting Soil Amendments Schedule (below) as amended through the results of the Agronomic Soil Fertility Report.
5. Thoroughly cultivate/blend all materials to provide a homogenous planting soil mixture at the indicated depth:
 - a. Depth of Cultivation: Minimum Ten-inches (10").
6. Tamp/compact prepared Planting Soil as required to eliminate settlement, and complete finish grading operations per Section 312219 – Landscape Grading.
7. Planting Soil Amendment Schedule:

<u>Soil Amendment/Fertilizer</u>	<u>Ratio</u>
First Component of Soil Conditioner Blend: Bulk Composted Organic Soil Amendment	Four (4) cu. yds. / 1,000 square feet of planting area.
Second Component of Soil Conditioner Blend: Granular Soil Conditioning Material & Fertilizer	At indicated ratio, per selected Manufacturer.
Gypsum	200 pounds / 1,000 square feet.
Commercial Fertilizer	At indicated ratio, per selected Manufacturer.
Soil Sulfur	8 pounds / 1,000 square feet of planting area.
Iron (non-staining)	10 pounds / 1,000 square feet of planting area.

- a. Modifications: The Planting Soil Amendment Schedule may be modified, based on the combined results of the Agronomic Soil Fertility Tests and Percolation Tests.
 - 1) Contractor shall be provided with fair and adequate compensation by the Owner should additions or increases to the specified ratios are required to

- the Planting Soil Amendment Schedule due to the Agronomic Soil Fertility Test results and/or recommendations by the Landscape Architect.
- 2) Contractor shall provide the Owner fair and adequate credit should subtractions or decreases to the specified ratios are required to the Planting Soil Amendment Schedule due to the Agronomic Soil Fertility Test results and/or recommendations by the Landscape Architect.
8. Complete finish grading operations per Section 312219 – Landscape Grading.

6. APPLICATION RATES

- A. Fertilizer Tablets shall be spread equidistantly around the perimeter within the Amended Planting Backfill Mixture, up to within three-inches (3”) of the finished grade of the Mixture, and at the following rates:

<u>Size of Plant Material</u>	<u>Total Quantity of 7-gram Fertilizer Tablets</u>
Liner, Plug, Flat-Size Plant, or 4” Pot.	One (1) Tablet
One (1)-gallon Container stock.	Three (3) Tablets
Five (5)-gallon Container stock.	Nine (9) Tablets
Fifteen (15)-gallon container stock	Fifteen (15) Tablets
24” Box Container Stock	Sixteen (16) Tablets
30” Box Container Stock	Eighteen (18) Tablets
36” Box Container Stock	Twenty (20) Tablets
42” Box Container Stock	Twenty-two (22) Tablets
48” Box Container Stock	Twenty-four (24) Tablets
60” Box Container Stock	Thirty-six (36) Tablets
For Container Stock larger than 60” Box.	Six (6) Tablets for each ½” of tree caliper size.
For each 1’-0” of Palm Tree (apical meristem) height. (Example: a 25’ Palm tree requires 50 tablets)	Two (2) Tablets.

1. Contractor shall not provide Fertilizer Tablets for designated native plant species, as indicated in the Contract Drawings or as directed by the Landscape Architect. Contractor shall verify with the Landscape Architect, in writing, as to which plants are subject to not receive the Fertilizer Tablets.
- B. Mycorrhizal Inoculum Application Rate:
1. During application of Fertilizer/Planting Tablets, Mycorrhizal Inoculum shall be spread equidistantly around the perimeter within the Amended Planting Backfill Mixture, up to within three (3”) inches of the finished grade of the Mixture, at the prescribed application rate per the Manufacturer’s written recommendations.

7. DRAINAGE OF PLANTING AREAS

A. Surface Drainage:

1. Discrepancies: Provide proper surface drainage of planted areas. Submit in writing all discrepancies in the Contract Drawings or Specifications, or prior Work done by others, which Contractor feels precludes establishing proper drainage.
2. Correction: Include description of work required for correction or relief of said condition.

B. Detrimental Drainage, Soils and Obstructions:

1. Notification: Submit in writing all soils or drainage conditions considered detrimental to growth of plant materials. State condition and submit proposal and cost estimate for correcting condition.
2. Correction: Submit for acceptance a written proposal and cost estimate for the correction before proceeding with Work.
3. Obstructions: If rock, underground construction Work, tree roots, or other obstructions are encountered in the performance of Work under this Section, submit cost required to remove the obstructions to a depth of not less than six-inches (6") below the required soil depth.

8. CLEAN UP AND PROTECTION

- A. For Work under this Section, keep Work area in a clean, orderly, and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect site from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged Soil Preparation areas as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, and other items resulting from construction operations offsite as described herein this Section, as directed by the Landscape Architect.

END OF SECTION 329113 – SOIL PREPARATION

SECTION 329200 – LAWNS & GRASSES

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Turf Grass and/or Ornamental Groundcover (via sown seed, stolon, plug, or sod) planting installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Sodded Turf Grasses.
 - 2. Seeded Turf Grasses (Machine broadcast).
 - 3. Overseeding Sodded Turf Grass (Winter Dormancy).
- C. Related Sections. The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 328400 – Irrigation Systems.
 - 2. Section 312219 – Landscape Grading.
 - 3. Section 329113 – Soil Preparation.
 - 4. Section 329300 – Exterior Plants.
 - 5. Section 329400 – Landscape Planting Accessories.
 - 6. Section 329813 – Landscape Establishment Period.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASPA – American Sod Producers Association.
 - 2. AOSA – Association of Official Seed Analysts.
- B. Definitions:
 - 1. Plant Material(s): Refers to living plant species, inclusive of turf grass (via sown seed, stolons, and/or sod), ornamental grasses or groundcovers (via sown seed or sown plugs) for the Project.
 - 2. Planting Area (PA): As denoted on the Contract Drawings, shall refer to areas to be installed with Plant Material(s), or areas where existing vegetation shall be protected.
 - 3. Hydro-Mulching: Refers to the practice of sowing seeds (via hydro-seeding method) or stolons (via hydro-stolonizing method) together within a slurry mixture of water, fertilizer, cellulose (wood) fiber mulch, binder additive / soil and mulch tackifier, and other additives and materials, which is sprayed uniformly on a prepared soil surface through a pressurized distribution system.
- C. Measurements:
 - 1. SQ/FT: Measurement, in square-foot.

3. SUBMITTALS

- A. General:
 - 1. Collect information into a single Submittal for each element of construction and type of product identified under this Section for review.
 - 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 - 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
 - 1. Product Data: Manufacturer's current catalog cuts and specifications for materials included herein this Section.
 - 2. Certifications:
 - a. Certificates of inspection as required by law for transportation of each shipment of plant material as required.
 - 1) **Seed Certification:** Certification of turf grass seeds from seed vendor for each turf grass-seed mixture, stating the botanical and common name and percentage by weight of each species and variety, and percentage of purity, germination, weed seed, and insert materials. Include the year of production and date of packaging if applicable. Seed mix certificate shall also include incorporated fertilizer and rate of application for hydro-mulching, as applicable.
 - 2) **Sod Certification:** Certification of each seed mixture for sod, identifying sod source, including name and telephone number of supplier.
 - 3. Qualification Data, for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified.
 - 4. Meeting Notes from Pre-installation Conference.
- C. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if the required information is missing or not presented in the format as requested.
- D. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

4. QUALITY ASSURANCE & CONTROL

- A. Installer Qualifications:
 - 1. Requirement: Valid **California** C-27 (Landscaping Contractor) License.
 - 2. Installer's Field Supervision: Installer to maintain an experienced full-time supervisor on the Project site during times that installations under this Section are in progress.
- B. Plant Material Quality:
 - 1. Refer to requirements under Part II herein this Section.
- C. Observation: Landscape Architect may observe installation Work herein this Section at Project Site for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe installation of products for defects and to reject unsatisfactory or defective

material or installation at any time during progress of Work. Contractor shall remove rejected Work immediately from Project site.

5. DELIVERY, STORAGE, AND HANDLING

A. Seed:

1. Delivery: Furnish standard Seed in unopened and undamaged Manufacturer's standard containers bearing original certification labels showing quantity, analysis and name of Manufacturer.
2. Storage: Protect Seed from weather or other conditions that would damage or impair the effectiveness of the product.

B. Sod:

1. Harvest and Delivery: Harvest Sod from the source and deliver to Project Site within 24 hours. Deliver only as much Sod as can be installed in one (1) day's work. Carefully handle Sod accordingly to the requirements of the ASPA's "*Specifications for Turfgrass, Sod Materials, and Transplanting/Installing*".
2. Review: Sod not transplanted within this time period shall be reviewed by the Landscape Architect prior to installation.

C. Granular Soil Conditioning Material & Fertilizer:

1. Delivery: Furnish material in unopened and undamaged Manufacturer's standard containers bearing original certification labels showing quantity, analysis and name of Manufacturer.
2. Storage: Protect material from weather or other conditions that would damage or impair the effectiveness of the product.

6. PROJECT SITE CONDITIONS

A. General Requirements: Installation under this Section shall be performed only during the time of day and during seasons when satisfactory results can be expected, unless authorized by the Landscape Architect.

1. **Seeds:** Install immediately after finish grading and irrigation installation are accepted.
2. **Sod:** Install immediately after finish grading and irrigation installation are accepted.

B. Climate Restrictions: Do not install Plant Materials under this Section during rainy or inclement weather.

C. Hydro-Mulching Operations:

1. Irrigated Areas: Commence Work within fourteen (14) calendar days after the completion and acceptance of Soil Preparation (per Section 329113 – Soil Preparation.) in planting areas.
2. Un-irrigated Areas: Commence work only between October 1st through February 28th, or as directed by the Landscape Architect. Should Contractor commences installation outside of this time frame, Contractor is responsible to provide temporary irrigation, as required, to un-irrigated areas to insure proper germination and growth establishment of the hydro-mulching materials to satisfy a minimum of 95% coverage of the hydro-mulched areas to satisfy Final Acceptance requirements.

7. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

8. WARRANTY

- A. Time Period: Warrant Plant Materials under this Section are established and in a healthy and flourishing condition of active growth six (6) months from date of Final Acceptance.
- B. Appearance During Warranty:
 - 1. Turf Grass areas shall be free of dead or dying patches, and shall show foliage of a normal density, size and color.
 - 2. Ornamental Grass areas shall be free of dead or dying patches, and shall show foliage of a normal density, size and color.
- C. Delays: Delays caused by the Contractor in completing planting operations under this Section which extend the planting into more than one (1) planting season shall extend the Warranty Period correspondingly.
- D. Coverage: Warrant growth and coverage of installations under this Section to the effect that a minimum of 95% of the area planted shall be covered and of acceptable appearance with the specified planting after one (1) growing season, with no bare spots.
 - 1. Exceptions: Contractor shall not be held responsible for failures due to neglect by Owner, vandalism, or natural disaster during Warranty Period. Report such conditions in writing.

9. FINAL ACCEPTANCE AND LANDSCAPE ESTABLISHMENT PERIOD

- A. Refer to Section 329813 – Landscape Establishment Period.

2.PRODUCTS

1. TURF GRASS MATERIALS

- A. General:
 - 1. Provide seeded installation of Turf Grass areas as designated on the Contract Drawings.

2. Provide sodded installation of Turf Grass areas as designated on the Contract Drawings.
 - 3.
- B. Turf Grass Sod Material:
1. Provide certified Turf Grass Sod complying with ASPA's Specifications for thickness, size, strength, moisture content, and mowed height. Provide Sod of grass species and varieties selected, proportioned by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed.
 2. Sod shall consist of live, growing, mature nursery-grown field stock, and shall arrive with a lush appearance, uniform texture, and a deep green color typical of the selected turf grass species.
 3. Sod shall be machine-cut from the nursery field with a minimum of one-half inch (1/2") of soil that completely covers the roots of the Sod. Sod shall contain a healthy, virile root system of dense, strong, thickly matted roots throughout, with no dead or dry edges, and capable of vigorous growth and development when planted. Sod shall be sufficiently dense to bear handling and placement without tearing.
 4. Sod shall be free of thatch, diseases, and harmful insects, and reasonably free from noxious or broadleaf weeds or other grasses, and shall not contain any other matter deleterious to its growth or which might affect its subsistence or hardiness when transplanted.
 - a. Sod shall be considered "weed free" if no more than ten (10) weeds are found per 100 SF of Sod.
 - b. Entire lot of Sod shall be rejected if found to contain the following weeds: common Bermuda grass, quackgrass, nutgrass, johnsongrass, poison ivy, nimbleweed, thistle, bindweed, bentgrass, perennial sorrel, or brome grass.
 5. Turf Grass Sod Species: To Match Existing
- C. Turf Grass Seed Material : **To Match Existing**
1. Fresh, clean, dry, certified, new-crop Turf Grass Seed, complying with the AOSA's *"Rules for Testing Seeds"* for purity and germination tolerances.
 2. Provide Turf Grass Seed of specified grass species and variety, proportions by weight, and minimum percentages of purity, germination, and maximum percentage of weed seed.
 3. Turf Grass Seed Species: **To Match Existing**

3.EXECUTION

1. EXAMINATION

- A. Verification of Conditions:
1. Grades: Verify that grades are within one-inch (1") plus or minus (+/-) of the required finished grades. Verify that applicable soil preparation and erosion control materials have installed under other Sections of the Contract Specifications. Report all variations in writing.
 2. Irrigation System: Verify that the irrigation system is installed and 100% coverage of the subject area is complete, tested, and in full working order. Complete installation of the irrigation system is a prerequisite for commencing work under this Section.
 3. Stones, Weeds, and Debris: Verify that planting areas under this Section are clear of stones larger than 1-1/2 in. diameter, and that weeds, debris and other extraneous materials have been removed prior to installation.

2. PREPARATION

- A. Limit sub-grade preparation to areas that will be planted in the immediate future.
- B. Excessive Soil Moisture: Do not commence Work under this Section when Soil Moisture Content is so great that excessive compaction to the soil will occur during installation. Owner and/or Landscape Architect shall be the sole judges as to a acceptable soil moisture content.
- C. Inadequate Soil Moisture: Apply water, in quantity as necessary, to bring soil to a optimum moisture content for installation under this Section. Do not work soil when it is so dry that dust will form in air or where clods will not readily break apart.
- D. Cultivation of Slopes: Planting areas of 2:1 slopes and greater shall be ripped or cultivated to a depth of three inches (3") immediately prior to hydroseeding. Refer to Section 329113 – Soil Preparation.
- E. Hydro-mulching of Non-irrigated Grass/Wildflowers Areas: Installation shall only occur during the period between October 15th and December 1st.
- F. Erosion Control Fabric: Refer to Section 329400 – Landscape Planting Accessories.
- G. Contractor's Option: Perform manual hand seeding, machine, or hydro-mulching of planting areas.
- H. Overseeding: Verticut/Mow Bermuda Grass as low as possible, removing any top growth. Plug aerate, scarify, and de-thatch. Remove clippings.

3. TURF GRASS SEED INSTALLATION (HAND SEEDING OR MECHANICAL SPREADER)

- A. Seed Bed Preparation: Refer to Section 329113 – Soil Preparation.
- B. Moisten prepared planting areas before installation when soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
- C. Cultivation of Soil (non-slope areas): Roto-till or spade the planting area to a depth of four- to six- inches (4'-6"). Incorporate soil amendments and fertilizers, where required, to a depth of three-inches (3") to four-inches (4"). Rake and smooth out seed bed, and clean surface soil of roots, plants, sods, stones, clay lumps, and other extraneous materials harmful to plant growth.
- D. Grade accordingly to maintain positive drainage, as applicable.
- E. Allowance Period for Soil Settlement: Commence seeding installation only after cultivation of soil and finish grading operations have been completed, and planting area has been permitted to settle under full irrigation for a minimum of two (2) weeks.
- F. Compaction and Final Grading: Contractor shall provide sod beds that will not "footprint". Lightly rake and roll soil with 200-pound water-ballast roller (filled 1/3 – 1/2 full), and bring level firm to finish grade. Final rolling shall be at right angles to slopes to prevent erosion. Sub-soil finish grade shall be sufficiently below the final grade to allow for the thickness of the seed bed. Where applicable, newly seeded areas shall blend and match with existing turf grass areas so as to produce a smooth, unified field of turf grass.

- G. Raking: After rolling, lightly rake and smooth seed bed surface to 1/4 in. depth. Seed immediately thereafter, provided the seedbed has remained in a friable condition.
- H. Turf Grass Seeding Operations (via Hand Seeding or Mechanical Spreader):
 - 1. Restrictions: Do not broadcast seed when winds exceed fifteen (15) mph.
 - 2. Mechanical Seeder: Sow evenly with an accepted mechanical seeder/culti-packer that covers the seed and forms the seedbed in one (1) operation.
 - 3. Sowing Seeds:
 - a. Broadcast half of the seed mix, evenly distributed over entire seed bed.
 - b. Broadcast remaining half of seed mix at right angles to first pattern, using same method.
 - 4. Areas inaccessible to mechanical culti-packer: Hand broadcast seed and rake seeded ground with flexible rakes. Do not change finish grades. Roll seeded area with roller weighing 150 lbs. per foot of roller width.
 - 5. Peat Humus: Dust on 1/4 in. thick layer of Peat Humus uniformly over seeded bed.
 - 6. Top-dress Fertilizer: Evenly apply at the rate indicated per the manufacturer's latest printed instructions, per 1,000 square feet, at twenty-five (25) days and at fifty (50) days after seeding.
- I. Initial Watering: Water with fine spray until seed bed is moistened to a depth of four-inches (4"). Do not use a jet nozzle or permit disturbance of surface of seed bed.
 - 1. During first week, water daily to supplement rainfall as necessary to maintain moist soil to a minimum depth of two-inches (2") below the surface until seed has germinated. Repeat watering at regular intervals until seed has thoroughly and adequately established itself.
 - 2. Protect seeded areas against hot, dry weather or drying winds. Apply supplemental water, in quantity as required, under these adverse conditions.
 - 3. Once established, decrease the watering frequency and increase the amount of water per application, as required to maintain adequate growth.
- J. Protection on Site: Erect temporary barricades, warning signs & flags, as required, protecting seeded areas against vehicular and pedestrian traffic until seeded areas have established growth to the satisfaction of the Owner or Landscape Architect.

4. TURF GRASS SOD INSTALLATION

- A. Delivery: Sod slabs shall be delivered on pallets and installed at the Project Site within twenty-four (24) hours after harvesting. Sod not installed within this time period shall be inspected and approved or rejected by the Landscape Architect. Do not lay sod if dormant.
- B. Protection: Protect root system of the sod from exposure from the weather, including dehydration, contamination, and heating during transportation to the site and delivery. In hot, dry, or windy weather conditions, stacked sod at the Project Site shall be lightly sprinkled with water to prevent sod slab edges from drying out.
- C. Allowance Period for Soil Settlement: Turf Grass Sod installation shall be started only after soil preparation and finish grading has been completed and soil has been permitted to settle under full irrigation during deep-water leaching operations for a minimum of two (2) weeks.
- D. After Allowance Period of Soil Settlement has expired, the areas to be sodded shall be loosened to a depth of two-inches (2"), raked, and floated to the final finished grade by a standard acceptable method. Finished areas shall be kept moist, even, and smooth, free from ridges and depressions, rocks, debris, and dirt clods, and reasonably well firmed.

- E. Compaction and Final Grading: Contractor shall provide sod beds that will not “footprint. Lightly rake and roll soil with two-hundred (200) pound water-ballast roller (filled 1/3 – 1/2 full), and bring level firm to finish grade. Final rolling shall be at right angles to slopes to prevent erosion. Sub-soil finish grade shall be sufficiently below the final grade to allow for the thickness of the sod material. Where applicable, newly sodded areas shall blend and match with existing turf grass areas so as to produce a smooth, unified field of turf grass.
- F. Application of Fertilizer: Apply the Pre-plant Starter Fertilizer evenly throughout the area to be sodded, at the prescribed application rate. Evenly distribute fertilizer by applying equal quantities in two (2) directions at right angles to each other.
- G. Raking: After broadcasting starter fertilizer, lightly rake and smooth seed bed surface to 1/4 in. depth. Install sod immediately thereafter, provided the sod bed has remained in a friable condition.
- H. Sodding Operations:
 - 1. Lay sod to form a solid mass with tightly fitted butt joints, with “green-side up”.
 - 2. Starter Strip: Lay first row of sod in a straight line, with subsequent rows parallel to and tightly against each other.
 - 3. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads (in a running-bond-type pattern) to offset joints in adjacent courses.
 - 4. Avoid damage to sub-grade or sod during installation.
 - 5. Tamp and roll lightly to ensure full contact with sub-grade, 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.
 - 6. Lay sod parallel to the lay of the sodded area. Lay sod across angle of slopes exceeding 3:1, beginning at the bottom of slope area.
 - 7. Anchor sod on slopes exceeding 6:1 with wood stakes spaced at two (2) pegs per square yard. Provide not less than two (2) anchors per sod strip to prevent slippage.
 - 8. Mulch Ring at Sod in Turf Grass Areas: Trim sod in clean diameter circles around the perimeter of trees planted in turf grass areas, as indicated on the Contract Drawings. The Mulch Ring circles shall have the tree trunk located in the middle of the circle. Provide Organic Wood Mulch in these areas, at the designated thickness specified herein this Section.
- I. Initial Watering: Saturate sod with fine water spray within two (2) hours of planting. Do not lay entire amount of sod before beginning watering. Water in lightly, when a relatively large area of sod has been placed.
 - 1. During first week, water daily to supplement rainfall as necessary to maintain moist soil to a minimum depth of two-inches (2”) below the sod until sod has rooted. Repeat watering at regular intervals until sod has established itself.
 - 2. Once established, decrease the watering frequency and increase the amount of water per application.
- J. Protection on Site: Erect temporary barricades, warning signs & flags, as required. Protect the sodded areas against vehicular and pedestrian traffic until sodded areas have established growth to the satisfaction of the Owner or Landscape Architect.
- K. Sod Establishment:
 - 1. Mow and maintain turf height recommended by the turf grass nursery. Do not cut more than 40% of the total grass blade length in one (1) single mowing.
 - 2. Replace dead or dying sod with new sod.
 - 3. Eradicate weeds between second and third mowing. Apply herbicides uniformly at the Manufacturer’s recommended rate.

4. Apply a second application of the Pre-plant Starter Fertilizer uniformly to the surface at the Manufacturer's recommended application rate thirty (30) days after seeding.
5. Dispose of protective barricades and warning signs at the termination of the sod establishment period.

5. OVERSEEDING SODDED TURF GRASS

- A. Preparation: Prepare Sodded Turf Grass bed to receive overseeding installation. Following verticutting/mowing, scarification, and dethatching, apply seed.
- B. Turf Grass Seeding Operations (via Hand Seeding or Mechanical Spreader):
 1. Restrictions: Do not broadcast seed when winds exceed fifteen (15) mph.
 2. Mechanical Seeder: Sow evenly with an accepted mechanical seeder/culti-packer that covers the seed and forms the seedbed in one (1) operation.
 3. Sowing Seeds:
 - a. Broadcast half of the seed mix, evenly distributed over entire seed bed.
 - b. Broadcast remaining half of seed mix at right angles to first pattern, using same method.
 4. Areas inaccessible to mechanical culti-packer: Hand broadcast seed and rake seeded ground with flexible rakes. Do not change finish grades. Roll seeded area with roller weighing 150 lbs. per foot of roller width.
 5. Peat Humus: Dust on 1/4 in. thick layer of Peat Humus uniformly over seeded bed.
 6. Top-dress Fertilizer: Evenly apply at the rate indicated per the manufacturer's latest printed instructions, per 1,000 square feet, at 25 days and at 50 days after seeding.
- C. Initial Watering: Water with fine spray until seed bed is moistened to a depth of four-inches (4"). Do not use a jet nozzle or permit disturbance of surface of seed bed.
 1. During first week, water daily to supplement rainfall as necessary to maintain moist soil to a minimum depth of two-inches (2") below the surface until seed has germinated. Repeat watering at regular intervals until seed has thoroughly and adequately established itself.
 2. Protect seeded areas against hot, dry weather or drying winds. Apply supplemental water, in quantity as required, under these adverse conditions.
 3. Once established, decrease the watering frequency and increase the amount of water per application, as required to maintain adequate growth.
- D. Protection of Site: Erect temporary barricades, warning signs & flags, as required, protecting seeded areas against vehicular and pedestrian traffic until seeded areas have established growth to the satisfaction of the Owner or Landscape Architect.

6. FIELD QUALITY CONTROL

- A. Tests: Samples of materials may be taken and tested for conformity to the Contract Specifications at any time by the Landscape Architect.
- B. Rejected Materials: Remove rejected materials immediately from the site at Contractor's expense. Pay cost of testing of materials not meeting the Contract Specifications.
- C. Intent: A consistent, thriving, and even cover of installed seed, sod, stolons, plugs, or hydro-mulching materials is the intent of this Section.
- D. Satisfactory Installation Performance Standards:

1. Turf Grass Seed: A consistent, thriving, and even cover of installed seeding materials is the intent of this Section. At the end of the Landscape Establishment Period, a healthy, uniform, close stand of seeded turf grass has been established, free of weeds and surface irregularities, at 100% percent full coverage with no bare spots. Provide additional seed, as required, to meet design intent. Failure to comply with this requirement shall extend the Landscape Establishment Period accordingly until the requirement is met.
2. Turf Grass Sod: A consistent, thriving, and even cover of installed sod materials is the intent of this Section. At the end of the Landscape Establishment Period, a healthy, uniform, close stand of sodded turf grass has been established, free of weeds and surface irregularities, at 100% percent full coverage with no bare spots. Provide additional sod, as required, to meet design intent. Failure to comply with this requirement shall extend the Landscape Establishment Period accordingly until the requirement is met.
3. Hydro-Mulching Applications: At the end of the Landscape Establishment Period, a healthy, uniform, close stand of hydro-mulched plant material has been established, free of weeds and surface irregularities, with coverage exceeding 95% percent coverage with no bare spots exceeding 6" inches. Failure to comply with this requirement shall extend the Landscape Establishment Period accordingly until satisfactory installation requirements are met.

7. CLEANING

- A. Hydro-mulching Overspray: Upon completion of hydro-mulching operations, clean off any slurry overspray from drainage devices, paving surfaces, plant materials, and site or architectural features. Contractor shall exercise caution in cleaning these areas so as not to wash away previously hydro-mulched areas (as applicable).
- B. Erosion: Immediately restore eroded areas. Keep adjacent paved surfaces cleaned of dirt, mud or stains and organic debris.

END OF SECTION

SECTION 329300 – EXTERIOR PLANTS

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Exterior Landscape Planting installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Trees.
 - 2. Shrubs.
 - 3. Ground Covers.
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 025639 – Temporary Tree and Plant Protection.
 - 2. Section 311000 – Site Clearing.
 - 3. Section 312219 – Landscape Grading.
 - 4. Section 328400 – Irrigation Systems.
 - 5. Section 329113 – Soil Preparation.
 - 6. Section 329200 – Lawns and Grasses.
 - 7. Section 329400 – Landscape Planting Accessories.
 - 8. Section 329813 – Landscape Establishment Period.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing Materials.
 - 2. USDA – United States Department of Agriculture.
 - 3. ANSI – American National Standards Institute.
- B. Reference Standards:
 - 1. *An Annotated Checklist of Woody Ornamental Plants of California, Oregon, and Washington*, (Number 4091), McClintock and Leiser, Division of Agricultural Sciences, University of California, 1979.
 - 2. *American National Standard for Nursery Stock (ANSI Z60.1)*. American National Standards Institute, and American Association of Nurserymen, Latest edition,
 - 3. *American Joint Committee on Horticultural Nomenclature*, 1942 Edition of Standardized Plant Names.
 - 4. *Hortus III*, 1976 Edition, Liberty Hyde Bailey Hortorium, Cornell University.
 - 5. *The Hillier Gardener's Guide to Trees and Shrubs*, 4th Edition, 1978.
 - 6. *Manual of Cultivated Conifers*, Den Ouden & Boon, 1978.
 - 7. *Datscape Guide to Commercial Nomenclature*, American Nurserymen Publishing Co., Chicago, IL, 1994.
 - 8. *American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300)*, American National Standards Institute, Latest Edition.

C. Definitions:

1. *Plant Material(s)* – Refers to living plant species, inclusive of trees, shrubs, groundcovers, vines, ornamental grasses, cacti/succulents, espaliers, annuals, perennials, etc., as indicated in the Contract Drawings.
2. *Planting Area (PA)* – As denoted on the Contract Drawings, shall refer to areas to be installed with Plant Material(s), or areas where existing vegetation shall be protected.
3. *Plant Height* – Measurement of main body height, not measurement to branch tip.
4. *Plant Spread* – Measurement of main body diameter, not measurement from branch tip to branch tip.
5. *Amended Planting Backfill Mixture* – Refer to Section 329113 – Soil Preparation.
6. *Balled and Burlapped Stock* – Healthy, vigorous exterior plants with firm, natural balls of earth in which they are grown, with ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of tree or shrub required; wrapped, tied, rigidly supported, and drum laced as recommended by ANSI Z60.1.
7. *Balled and Potted Stock* – Healthy, vigorous exterior plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of exterior plant required.
8. *Bare-Root Stock* – Healthy, vigorous exterior plants grown with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of exterior plant required.
9. *Clump* – Where three or more young trees were planted in a group and have grown together as a single tree having three or more main stems or trunks.
10. *Container-Grown Stock* – Healthy, vigorous, well-rooted exterior plants grown in a container with well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of exterior plant required.
11. *Fabric Bag-Grown Stock* – Healthy, vigorous, well-rooted exterior plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of exterior plant.
12. *Finish Grade* – Elevation of finished surface of planting soil.
13. *Manufactured Topsoil* – Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.
14. *Multi-Stem* – Where three (3) or more main stems arise from the ground from a single root crown or at a point right above the root crown.
15. *Sub-grade* – Surface or elevation of subsoil remaining after completing excavation, or top surface of a fill or backfill, before placing planting soil.
16. *Subsoil* – All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

D. Measurements:

1. sq/ft or SF: Measurement, in square-foot.
2. O.C.: Measurement used for On-Center spacing.

3. SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.

2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Alphabetized List of Plant Material.
2. Planting Installation Schedule:
 - a. Provide anticipated site area(s) and dates of installation for each type of planting.
3. Qualification Data, for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and address of architects and owners, and other information specified.
4. Meeting Notes from Pre-installation Conference.
5. Description of Plant Material, for each species indicated in the Contract Drawings, submitted in the following format:

(Provide Color Photograph of Plant Material here)

(Note: Photograph shall include a person, tape measurer, or other scaled reference).

<i>Project Name:</i>	
<i>Botanical Name:</i>	
<i>Common Name:</i>	
<i>Form (Multi, Standard, etc.):</i>	
<i>Container Size (as applicable):</i>	
<i>Overall Height (provide Apical Meristem Height for Palms):</i>	
<i>Spread:</i>	
<i>Caliper (as applicable):</i>	
<i>Quantity Required (per Contract Drawings):</i>	
<i>Quantity Available (at supplying Nursery):</i>	
<i>Supplying Nursery Name:</i>	
<i>Contact Name at Nursery:</i>	
<i>Nursery Address:</i>	
<i>Nursery Phone Number:</i>	
<i>Date of Nursery Photo:</i>	
<i>Comments/Remarks:</i>	

6. The Alphabetized List of Plant Material and Description of Plant Material shall not be construed as to acceptance of the Plant Material. All Plant Material shall be subject to review and approval by the Landscape Architect upon delivery to the Project Site.
- C. Submittals under this Article will be rejected without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if the required information is missing or not presented in the format as requested.
- D. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

4. QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications:
 1. Requirement: Valid **California** C-27 (Landscaping Contractor) License.
 2. Engage an experienced Installer who has demonstrated completed landscaping work similar in material, design, and extent to that indicated for this Project and with a record of successful landscape establishment.
 3. Installer's Field Supervision: Installer shall maintain an experienced full-time supervisor on the Project site during times that landscaping installations under this Section are in progress.
- B. Plant Material: Provide quality, size, genus, species, and variety of Plant Material indicated, complying with applicable requirements of ANSI Z60.1 "American Standard for Nursery Stock."
 1. Selection of Plant Material purchased under allowances will be made by the Owner, who has the option to tag Plant Material stock at their place of growth before they are prepared for transplanting.
 2. At least one (1) plant of each Plant Material species delivered to the Project Site shall have an identification tag from supplying nursery showing botanical and common name of the plant as identified in the Contract Drawings. Landscape Architect shall be provided the opportunity for an on-site debriefing by the Contractor that identifies the size and specific type of Plant Material upon delivery.
 3. Incorrect Planting Materials:
 - a. Replace, at no cost to Owner, Plant Material that is revealed during the course of the Contract as to being untrue to the species indicated in the Contract Drawings and reviewed accordingly under this Section.
 - b. Provide replacements equal to the size and quality to match the planted materials at the time the untrue species is discovered.
 4. Replacement of Plant Material: Refer to the Guarantee Article indicated herein this Section.
- C. Observation: Landscape Architect may observe Plant Materials at their place of growth (nursery), at the site before or after planting, or both, for compliance with requirements for genus, species, variety, size and quality. Landscape Architect also retains right to observe Plant Material further for size and condition of root balls, trunks, branches, and crowns; insects; pests; disease; weeds; injuries, and latent defects. Landscape Architect reserves the right to reject unsatisfactory and/or defective Plant Material at any time during progress of Work. Contractor shall remove rejected Plant Material immediately from Project site.
- D. Regulatory Requirements:

1. Contractor shall meet the requirements of applicable laws, codes, and regulations as required by the authorities having jurisdiction over the Work.
 2. Provide for inspections and permits by Federal, State, and Local authorities in furnishing, transporting, and installing materials.
- E. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, and inspections necessary to perform and complete Work under this Section.
- F. Plant Material Review and Selection (Tagging):
1. At the discretion of the Landscape Architect, Plant Material will be subject to review, photographed, and selected/tagged by the Landscape Architect at the nursery, or other place of growth, prior to delivery to the Project Site. Contractor shall verify with the Landscape Architect if tagging operations are required.
 2. Selecting/Tagging of Plant Materials at the nursery or place of growth does not cancel the right of the Landscape Architect to reject Plant Materials at the Project Site, if damaged or unacceptable conditions are found that were not detected at the nursery, place of growth, or in the submitted photographs.
- G. Plant Material Delivery: Plant Material shall be delivered with original Plant Material tagging materials set in place, as selected and marked by the Landscape Architect at the nursery or place of growth. Contractor shall notify Landscape Architect upon deliver of Plant Material for review of stock and tagging materials. Plant Materials delivered without original tagging materials, or with broken, damaged, or altered tagging materials, shall be subject to rejection by the Landscape Architect. Rejected Plant Material shall be removed immediately.
- H. Pre-installation Conference: Conduct conference at Project Site to comply with requirements of Division 1 Section "Project Meetings".
- I. Protection of Existing Plant Material:
1. Refer to Requirements specified in Section 025639 – Temporary Tree and Plant Protection.
 2. It is the intent of the Contract Documents that certain existing Plant Materials shall be retained. Prior to the removal of any Plant Materials, the Contractor shall confer with the Landscape Architect to determine which Plant Materials are to remain.
 3. All existing Plant Materials which are to remain in the project shall be tagged and identified by the Contractor prior to start of Work.
 4. Contractor shall be responsible for Plant Materials that are designated to remain. Damage to any Plant Materials which results in death or permanent disfiguration of said Materials shall result in compensation outlined in Section 025639 – Temporary Tree and Plant Protection. The Landscape Architect shall be the sole judge of the condition of the Plant Materials.
 5. Existing Plant Materials designated to remain shall be protected at all times from damage by construction activity (tools, materials, equipment, personnel, etc.). Damage by the Contractor to existing Plant Materials shall be repaired at the Contractor's expense to the satisfaction of the Owner, as directed by the Landscape Architect.
 6. Contractor shall insure that no foreign material and/or liquid, such as paint, concrete, cement, oil, turpentine, acid or the like, be deposited or allowed to be deposited on soil within the drip line (the outside edge of the foliage overhang) of any Plant Material. Do not store construction materials, debris, or excavated material within drip line of existing Plant Material. Should any such poisoning of the soil occur, the Contractor shall thoroughly remove said soil as directed by the Landscape Architect and replace with acceptable soil at no additional cost to the Owner.
 7. Excavation adjacent to existing Plant Materials: Where it is necessary to excavate in close proximity to the drip lines of existing Plant Materials, all possible caution shall be

exercised to avoid injury to roots and trunk. Excavation close to Plant Materials shall be done by hand, with narrow-tine spading forks or other approved tools to comb soil to expose roots. Tunnel under roots two-inches (2") and larger in diameter. Cutting of roots two-inches (2") and larger shall be only on the approval of the Landscape Architect.

8. Replacement of Damaged Plant Material: Replace existing Plant Material to remain as required, that are damaged by Contractor during construction with accepted Plant Material of the same species, size, and quantity as those damaged, at no additional cost to Owner. Owner shall be the sole judge as to the extent of the damage and the value of said damaged Plant Material.

5. DELIVERY, STORAGE, AND HANDLING

- A. General: Do not prune Plant Material before delivery, except as approved by the Landscape Architect. Protect bark, branches, and root systems from sun scald, drying, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie Plant Material in such a manner as to destroy natural shape.
 1. Immediately after digging field-grown Plant Materials, pack root systems in wet straw, hay, burlap, or other suitable material to keep root system moist until final planting installation.
 2. Deliver freshly dug field-grown Plant Materials with firm, natural balls of earth of sufficient depth to include fibrous and feeding roots, meeting or exceeding requirements of ANSI Z60.1 for root ball diameter.
- B. Handling Plant Materials:
 1. Handle balled and burlap Plant Material stock by the root ball.
 2. Handle container-grown Plant Materials only by their containers.
 3. DO NOT handle Plant Materials by their trunks or stems.
 4. DO NOT drop any Plant Materials.
 5. DO NOT bind or handle Plant Materials with wire or rope.
 6. Pad trunk and branches of Plant Materials whenever using hoisting cables, chains, or straps.
 7. Should the Contractor engage in handling any Plant Material(s) by any unacceptable method(s), the Landscape Architect shall reserve the right to reject any of the mishandled Plant Material(s). The Contractor shall replace rejected Plant Material(s) with approved Plant Material(s), at no additional cost to the Owner.
- C. Delivery: Provide protective covering during delivery. Deliver Plant Material only after preparations for planting have been completed and install immediately. If planting is delayed more than six (6) hours after delivery, set Plant Materials in shade, protect from weather and mechanical damage, and keep roots moist. Anchor plants to prevent damage from winds.
 1. Heel-in bare-root Plant Material stock. Soak roots in water for two (2) hours prior to planting.
 2. Set balled Plant Material stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
 3. DO NOT remove container-grown Plant Material stock from containers before time of planting.
 4. Water root systems of Plant Material stored on site with a fine-mist spray. Water as often as necessary to maintain root systems in a moist condition.

6. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Acceptance: Do not install Plant Materials prior to acceptance of finish grades and installation of irrigation system.
- B. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease planting operations and notify Landscape Architect for further direction.
- D. Construction Site Observations: Landscape Architect may observe installation Work herein this Section at Project Site for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe installation of products and materials for defects and to reject unsatisfactory or defective product, material, or installation at any time during progress of Work. Contractor shall remove rejected Work immediately from Project site. Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. PROJECT SITE CONDITIONS

- A. General: Installation of Plant Materials shall be performed only during the time of day and during seasons when satisfactory results can be expected, unless authorized by the Landscape Architect.
- B. Climate Restrictions: Do not install Plant Materials during rainy or inclement weather.

8. SUBSTITUTIONS

- A. Consideration: Plant Materials to be considered equal to the Plant Materials indicated herein this Section shall be reviewed by the Landscape Architect. Plant Materials with equal performance characteristics may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, or intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
 - 1. Substituted Plant Materials shall be true to species and variety and shall conform to measurements specified, except that plants larger than specified may be used if accepted. If larger Plant Materials are accepted, increase the ball of earth in proportion to the size of the plant, as required. Plant Materials overgrown for their container size will be rejected.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Plant Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Plant Materials under this Section shall not increase the Contract price.

9. WARRANTY

- A. General: The Warranty indicated herein in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract, and shall be in addition to, and run concurrent with, other guarantees or warranties made by the Contractor under requirements of the Contract Documents.
- B. Warranty: Contractor shall warrant living Plant Materials under this Section for a period of one (1) year after date of Substantial Completion. Warrant against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by the Owner; abnormal weather conditions unusual for the Warranty Period; or incidents which are beyond the Contractor's control.
- C. Replacement of Plant Material:
 - 1. Replace Plant Materials exhibiting conditions which are determined to be unacceptable due to workmanship by the Contractor, at no cost to the Owner, per the direction of the Landscape Architect.
 - 2. Remove and replace dead or dying Plant Material immediately unless required to plant in the succeeding planting season.
 - 3. Contractor shall be held responsible for a maximum of two (2) replacement of each failed Plant Material after Final Acceptance during the Warranty Period.
 - a. Closely match replacements to adjacent specimens of the same species. Apply requirements of this Specification to replacements.

10. FINAL ACCEPTANCE AND LANDSCAPE ESTABLISHMENT PERIOD

- A. Refer to Section 329813 – Landscape Establishment Period.

2.PRODUCTS

1. GENERAL REQUIREMENTS FOR PLANT MATERIAL

- A. Immediately upon award of Contract for Work in this Section, Contractor shall locate and purchase or hold for purchase plant material as required.
 - 1. Contractor shall verify with Landscape Architect of Plant Material that has been nursery “contract grown” by the Owner for use of Work under this Contract.
 - 2. Contractor shall review the condition of the Plant Material with Landscape Architect at the nursery maintaining the Plant Material prior to delivery, and when delivered to the Project Site.
- B. Quality: Plant Materials shall have a growth habit typical for each variety and species indicated in the Plant List (as detailed on the Contract Drawings).
 - 1. All Plant Materials specified shall be superior/premium-grade nursery stock, full, densely foliated, symmetrical, with tightly knit branching, so trained or favored in development and appearance in form, number of branches, compactness and symmetry, healthy, and vigorous in growth, as reviewed and determined by the Landscape Architect.
 - 2. Plant Materials shall be free from insect pests, eggs and larvae, plant diseases, sun scalds, fresh bark abrasions, excessive abrasions, windburn, salt burn, weeds, or other disfigurements or conditions, as reviewed and determined by the Landscape Architect.
 - 3. Plant Material shall be subject per the California State Department of Agriculture’s Regulations for Nursery Inspections of Rules and Grading.

4. Growing Conditions: Plant Materials shall be nursery-grown in accordance with good horticultural practices under climatic conditions similar to those of project unless otherwise specifically authorized.
- C. Container Stock (excluding annuals) shall be grown in boxes or containers in which delivered for at least one (1) growing season, but not over two (2) years. Plant Material grown in boxes or containers shall be cultivated during this time to permit full rooting within the specified box or container to bind the planting soil, but not so long as to create a “root-bound” condition.
1. Plant Material shall be completely free of circling, kinked or girdling trunk surface and center roots, and show no evidence of a pot-bound condition.
 2. No boxed nor container Plant Material shall be planted which have cracked or broken balls of earth when separated from their boxes or containers.
 3. No Plant Material shall be planted with damaged roots, broken root balls, or which are found to be “root-bound” when separated from their containers.
- D. Pruning:
1. Do not prune Plant Materials unless directed by the Landscape Architect.
 2. Pruning of Plant Material as grown at the nursery shall conform to ANSI A300 standards.
 3. Consult with Landscape Architect for pruning Plant Materials after delivery and installation.
- E. Measurements: Measure Plant Material according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes.
1. Take caliper measurement at a point on the trunk six-inches (6”) above natural ground line for trees up to four-inches (4”) in caliper (at a point twelve-inches (12”) above the natural ground line for trees over four-inches (4”) in caliper).
 - a. Measure foliage across mean foliage dimension when branches are in their normal upright position.
 - b. For trees to be supplied in “raised up” condition, foliage origin along main trunk shall be measured from soil line after installation.
 - c. Height and spread dimensions specified refer to main body of plant and not branch tip to tip. Properly trimmed plants shall measure the same in any direction. If a plant is unevenly grown, it shall be classified in the size category of the smallest dimension.
 2. Size Range: If a range of size is given, do not use Plant Materials less than the minimum size. The measurements specified are the minimum size acceptable and are the measurements after pruning, where pruning is required. Plant Materials that meet the measurements specified, but do not possess a normal balance between height and spread shall be rejected.
- F. Field Dug Stock: Prior to digging of field-grown Plant Materials, insure that excess loose fill resulting from cultivation around trunks/stems and over roots be removed down to natural finish grade at crown of Plant Materials. During digging, verify that size of tree spade or other equipment is adequate to encompass the actively growing root zone of all Plant Materials. Plant Materials which, after digging, show mostly large fleshy roots and few fibrous roots, will be rejected.
- G. Condition of Root Systems: Plant Materials must prove to be completely free of circling, kinked or girdling trunk surface and center roots and show no evidence of a root-bound condition. Upon inspection by Landscape Architect at the job site, if five-percent (5%) or more of the plants of each species are found to contain kinked, circling or girdling roots, all plants of that species shall be rejected.

- H. Unacceptable Trees: Trees that have damaged, broken, pruned, or crooked leaders will be rejected. Trees having a main leader shall not have been headed back. Trees with abrasions of the bark, sunscalds, disfiguring knots, or fresh cuts of limbs over 3/4 in. which have not completely callused will be rejected.

2. SHADE AND FLOWERING TREES

- A. Shade and Flowering Trees: Single-stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, conforming to ANSI Z60.1 for type of trees required, subject to review and acceptance by the Landscape Architect. Container-grown trees will be acceptable and shall be subject to meeting ANSI Z60.1 limitations for container stock.
 - 1. Branching Height: 1/2 of tree height, unless otherwise indicated on Contract Drawings.
- B. Small Trees: Small upright or spreading type, branched or pruned naturally according to species and type, and with relationship of caliper, height, and branching recommended by ANSI Z60.1, subject to review and acceptance by the Landscape Architect. Container-grown trees will be acceptable and shall be subject to meeting ANSI Z60.1 limitations for container stock.
 - 1. Form: As indicated on the Contract Drawings for individual selected species.
- C. Field Dug Specimen Trees:
 - 1. Form and Size: As specified on the Contract Documents for height, spread, and/or caliper, subject to review and acceptance by the Landscape Architect at the supplying nursery prior to delivery and installation. Provide superior quality, full, symmetrical, well-rooted, upright, spreading, with well-balanced crown.
 - 2. Throughout the duration of excavation, transport, delivery, storage, and installation, all Field Dug Specimen Trees shall have their root balls remain moist, firm and intact, with no damage. Provide metal cages, as required, to insure rootball stability. Any tree that exhibits a broken, damaged, or dry rootball at any time under the Contract shall be subject to immediate rejection by the Landscape Architect.

3. SHRUBS

- A. Form and Size: Shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of Shrub, subject to review and acceptance by the Landscape Architect. Container-grown Shrubs will be acceptable in lieu of balled and burlapped.
 - 1. Container-grown Shrubs shall be subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

4. CONIFEROUS EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, well-rooted, coniferous evergreens, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.
 - 1. Boxed or container-grown coniferous evergreens will subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

5. BROADLEAF EVERGREENS

- A. Form and Size: Normal-quality, well-balanced, well-rooted , broadleaf evergreens, of type, height, spread, and shape required, subject to review and acceptance by the Landscape Architect.
 - 1. Container-grown broadleaf evergreens shall be subject to meeting ANSI Z60.1 limitations for container stock, and other requirements as indicated on the Contract Drawings.

6. GROUND COVERS

- A. Provide ground covers full, established, and well-rooted in removable flats, containers, or integral peat pots, and with not less than the minimum number and length of runners required by ANSI Z60.1 for the container size indicated, and other requirements as indicated on the Contract Drawings, subject to review and acceptance by the Landscape Architect.

3.EXECUTION

1. EXAMINATION

- A. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED ACCORDINGLY BY THE LANDSCAPE ARCHITECT.
- B. Prior to commencing Work under this Section, Contractor shall examine previously installed Work from other trades and verify that such Work is complete and to the point where Work herein may commence properly. Do not proceed with Work until unsatisfactory conditions have been corrected.
- C. Installation practices of the Plant Materials shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practices, as judged by the Landscape Architect.
 - 1. Soil moisture levels prior to planting shall be no less than seventy-five-percent (75%) of field capacity. The determination of adequate soil moisture for planting shall be in the sole judgment of the Landscape Architect, and their decision shall be final.
 - a. If the soil moisture level is found to be insufficient for planting installation, planting pits shall be filled with water and allowed to drain before commencing planting operations.
 - b. Any planting area that may become compacted in excess of eighty-five-percent (85%) relative compaction (due to construction operations or other activities during the Contract) shall be tilled and thoroughly cross-ripped to a minimum depth of nine-inches (9”) to alleviate the condition, taking care to avoid all existing subsurface utilities, drainage, etc.
 - c. Do not commence planting installation prior to acceptance of Section 329113 – Soil Preparation.
- D. Contractor shall notify the Landscape Architect, in writing, on the anticipated commencement date and length of duration of the landscape installation.
- E. Preparation of Planting Installation: Lay out individual Plant Material locations and areas for multiple plantings. Stake locations, outline areas, and gain the Landscape Architect's acceptance prior to commencing physical planting installation.

- F. At the discretion of the Landscape Architect, Contractor shall make field adjustments to the planting layout, as required, per the direction of the Landscape Architect. Layout changes made accordingly shall be performed at no additional cost to the Owner.
- G. No more Plant Materials shall be distributed in the planting area on any day than can be installed and watered on that day. Plant Materials shall be planted and watered immediately after the removal of their containers, as applicable.
- H. Contractor shall protect existing and new improvements and systems installed prior to planting installation. Maintain protection in place until completion of Work and Landscape Establishment Period.
- I. Finish Grades for planting areas shall have been established (per Section 312219 – Landscape Grading) prior to Work under this Section. Verify that grades are within one-inch plus or minus (1" +/-) of the required finish grade, and that all proper soil amendments and fertilizers have been furnished and installed accordingly as specified (per Section 329113 – Soil Preparation).
 - 1. Maintain positive surface drainage of all planted areas throughout the duration of the Contract.
- J. Pre-Planting: Where Plant Materials are to be pre-planted to permit site improvements to be installed around them, Contractor shall be responsible for the accurate layout and placement of those Plant Materials, as measured to their centerlines. Confirm designated pre-planting operations with Landscape Architect prior to commencing Work. Contractor shall also be responsible for the protection of pre-planted Plant Materials while other Work is taking place around them. Provide regular irrigation, as necessary, prior to installation and functioning of irrigation systems (per Section 328400 – Irrigation Systems).

2. EXCAVATION FOR PLANT MATERIAL

- A. General: Upon completion of applicable pre-planting soil preparation requirements indicated in Section 329113 – Soil Preparation, excavate planting hole(s) for Plant Material with scarified vertical sides, with the bottom of the excavated hole slightly raised and compacted at the center to assist drainage and to minimize settlement of the Plant Material. Excavate holes according to the spacing alignment (i.e. hedge spacing, grid spacing, triangular spacing, etc.) and the on-center (O.C.) spacing intervals (i.e. 24" O.C. etc.) indicated on the Contract Drawings. Loosen any hard subsoil in the bottom of the excavation where evident, and remove all rocks greater than one-half-inch (1/2") in diameter, trash, debris, etc. Retain the excavated soil for use as part of the Amended Planting Backfill Mixture (as indicated in Section 329113 – Soil Preparation).
 - 1. Bare-Root Plant Material:
 - a. Excavate at least twenty-four-inches (24") wider than the perimeter of the bare root spread, and deep enough to allow setting of the roots on a compacted layer of native planting soil, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect.
 - b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
 - c. Where Tree Root Aeration Units are indicated (per Section 329400 – Landscape Planting Accessories), provide further excavation in the planting hole by auger to the required minimum depth allowing for installation of the Tree Root Aeration Unit assembly.
 - 2. Balled and Burlap Plant Material:
 - a. Excavate the planting hole to the width and depth indicated in the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the

- plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
 - b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
 - c. Where Tree Root Aeration Unit(s) are indicated (per Section 329400 – Landscape Planting Accessories provide further excavation in the planting hole by auger to the required minimum depth allowing for installation of the Tree Root Aeration Unit assembly.
 - 3. Container-Grown Plant Material:
 - a. Excavate the planting hole to the width and depth indicated on the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
 - b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
 - c. Where Tree Root Aeration Unit(s) are indicated, (per Section 329400 – Landscape Planting Accessories), provide further excavation in the planting hole by auger to the required minimum depth for installation of the Tree Root Aeration Unit assembly.
 - 4. Field Grown/Specimen Trees:
 - a. Excavate the planting hole to the width and depth indicated on the Contract Drawings. Depth of the planting hole includes the depth indicated for the compacted setting layer at the bottom of the excavation, where the top of the plant's root collar is one-inch (1") higher than finished grade or as further directed by the Landscape Architect:
 - b. Compacted Setting Layer: Provide a crown of a minimum six-inch (6") depth of native planting soil.
 - c. Where Tree Root Aeration Unit(s) are indicated (per Section 329400 – Landscape Planting Accessories), provide further excavation in the planting hole by auger to the required minimum depth for installation of the Tree Root Aeration Unit assembly.
 - d. In areas where special subsurface drainage for planting is indicated, tie drainage pipes, as required, into the drain system.
 - e. Excavate planting hole at 3x the diameter of the rootball.
 - B. Obstructions: Notify the Landscape Architect immediately if unexpected rock, debris, contaminants, obstructions, or other items that are detrimental to the healthy sustained growth of Plant Material is encountered in the excavation process.
 - 1. Hardpan Layer: If encountered, drill six-inch (6") diameter holes into free-draining strata or to a depth of ten-feet (10'), whichever is less, and backfill with free-draining material.
 - C. Drainage: Notify the Landscape Architect if subsoil conditions show evidence of unexpected water seepage or retention in planting holes.
3. PLANTING PLANT MATERIAL
- A. Bare Root Plant Material: Set Bare Root Plant Material plumb and in center of the excavated hole, with top of root ball set properly at the adjacent finish grade as indicated. Set Bare Root Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.

1. Thoroughly soak the roots of the Bare Root Plant Material in clean water for a minimum of twelve (12) hours but no more than twenty-four (24) hours to fully hydrate the root mass. Do not soak above the root crown.
2. Remove wood shavings or other material used to keep the exposed root mass in a moist condition.
3. Carefully place the Plant Material stock on the specified setting layer of compacted native soil, with the top of root mass set approximately one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide an orientation of the Plant Material that is confirmed and acceptable by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, carefully handle the Plant Material by its trunk.
4. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:
 - a. $\frac{1}{4}$ yard of Bulk Composted Organic Soil Amendment Material (per Section 329113 – Soil Preparation).
 - b. $\frac{1}{2}$ pound of Granular Soil Conditioning Material & Fertilizer (per Section 329113 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 329113 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.
 - a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
5. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required (per Section 329400 – Landscape Planting Accessories).
6. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the Plant Material root mass in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
 - b. Maintain the Plant Material plumb while working the Mixture around the root mass. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments, (per Section 329113 – Soil Preparation) as required, at the prescribed application rates (as indicated per Section 329113 – Soil Preparation) or if not indicated, per the Manufacturer's latest printed instructions.
 - d. Place the final layers of the Amended Planting Backfill Mixture, tamping accordingly, to the top of the root mass.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture (per Section 329400 – Landscape Planting Accessories). Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
7. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings. Refer to Section 329400) – Landscape Planting Accessories for type and requirements.

- B. Balled and Burlapped Plant Material: Set the Balled and Burlapped Plant Material plumb and in center of the excavated hole, with top of the root ball raised above adjacent finish grade as indicated. Set Balled and Burlapped Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.
1. Carefully place the Balled and Burlapped Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, handle the Plant Material by its root ball; avoid handling the Plant Material by its trunk.
 2. Once orientation is accepted, carefully remove the burlap and wire baskets from the tops of the root ball and partially from the sides, but do not remove from under the root ball. Do not damage the root ball or any part of the plant. Plant Material shall be rejected if the root ball is cracked or broken before or during the planting operation.
 3. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:
 - a. $\frac{1}{4}$ yard of Bulk Composted Organic Soil Amendment Material (per Section 329113 – Soil Preparation).
 - b. $\frac{1}{2}$ pound of Granular Soil Conditioning Material & Fertilizer (per Section 329113 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 329113 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.
 - a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
 4. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required (per Section 329400 – Landscape Planting Accessories).
 5. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
 - b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments, (per Section 329113 – Soil Preparation) as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
 - d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole. Do not cover the top of the root ball with the backfill mixture.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture (per Section 329400 – Landscape Planting Accessories). Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air

- pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
6. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings. Refer to Section 329400 – Landscape Planting Accessories for type and requirements.
- C. Container-Grown Plant Material: Set Container-Grown Plant Material plumb and in the center of the excavated planting hole, with top of the root ball raised above adjacent finish grade as indicated. Set Container-Grown Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.
1. For plastic container stock (4" pot, 1-gallon, 5-gallon, 15-gallon, etc.), carefully remove the plant container prior to setting the plant in the excavated hole so as not to damage root ball. Tip container to horizontal position and shake carefully to remove Plant Material. Support root ball during installation to prevent cracking or shedding of soil.
 2. Set the Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the plant material, carefully handle the Plant Material by its container; avoid handling the Plant Material by its trunk.
 - a. Plant Material with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.
 3. For wooden boxed container stock, carefully set whole boxed container of the Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1") above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation, carefully handle the Plant Material by its container; avoid handling the Plant Material by its trunk or branches. Once orientation is accepted, remove the steel strapping and the sides of the wooden container so as not to damage the root ball or any part of the plant. Do not remove the bottom of the wooden container. Discard sides.
 - a. Plant Material with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.
 4. Scarification: After removing container from plant, scarify the sides of the root ball to a depth of one-inch (1") at four (4) to six (6) equally-spaced locations around the perimeter of the root ball or at twelve-inch (12") intervals on sides of wooden boxed container stock. Cut and remove circling roots over 3/8 in. diameter.
 5. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing/blending the following:
 - a. 1/4 yard of Bulk Composted Organic Soil Amendment Material (per Section 329113 – Soil Preparation).
 - b. 1/2 pound of Granular Soil Conditioning Material & Fertilizer (per Section 329113 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 329113 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.

- a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
6. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required (per Section 329400 – Landscape Planting Accessories).
7. In areas where indicated on the Contract Drawings, install the Deep Watering Bubblers as part of the irrigation system.
8. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6”) lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets. Foot tamp the backfill, as required.
 - b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments (per Section 329113 – Soil Preparation) as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer’s instructions.
 - d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
 - e. Dish and tamp top of the Mixture to form a three-inch (3”) deep watering basin centered on the Plant Material’s trunk to the rim width of the planting hole. Do not cover the top of the root ball with the backfill mixture.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture (per Section 329400 – Landscape Planting Accessories). Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
9. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings. Refer to Section 329400 – Landscape Planting Accessories for type and requirements.
- D. Field-Dug Specimen Plant Material: Set Field-Dug Specimen Plant Material plumb and in the center of the excavated planting hole, with top of the root ball raised above adjacent finish grades as indicated. Set Field-Dug Specimen Plant Material in the proper spacing and/or alignment(s) as indicated on the Contract Documents, or as further directed at the Project Site by the Landscape Architect.
 1. After excavation of the planting hole, provide subsurface piping drainage and/or Tree Root Aeration Units as indicated on the Contract Drawings. Tie subsurface drainage into storm drainage system, where required. Install the Tree Root Aeration Units, where required.
 2. Carefully set the Field-Dug Specimen Plant Material stock on the specified setting layer of compacted native soil, with the top of root ball set one-inch (1”) above the finished grade to allow for settlement of the Plant Material within the excavated planting hole. Provide the orientation of the Plant Material that is confirmed and accepted by the Landscape Architect. During the process of determining an acceptable orientation of the Plant Material, carefully handle the Plant Material by a cradle around its root ball mass or by its planting container; avoid handling the Plant Material by its trunk.
 - a. For Field-Dug Specimen Plant Material delivered in a wooden boxed container, do not remove sides or bottom of the container until the Specimen’s orientation is accepted by the Landscape Architect. Once orientation is accepted, remove steel strapping and the sides of the wooden container so as not to damage the root ball or

- any part of the Specimen. Do not remove the bottom of the wooden container. Discard sides.
- 1) Any Specimen with a damaged root ball upon removal of the container, or if the root ball fails to thoroughly hold the soil as it is removed from the container, or if the plant is mishandled or damaged during planting operations, shall be rejected.
 3. Scarification: After removing container from plant, scarify the sides of the root ball to a depth of one-inch (1") at four (4) to six (6) equally-spaced locations around the perimeter of the root ball or at twelve-inch (12") intervals on sides of wooden boxed container stock. Cut and remove circling roots over 3/8 in. diameter.
 4. Prepare the Amended Planting Backfill Mixture: Amend each cubic yard (cu/yd) of native soil excavated from the planting hole by incorporating and thoroughly mixing and blending in the following:
 - a. 1/4 yard of Bulk Composted Organic Soil Amendment Material (per Section 329113 – Soil Preparation).
 - b. 1/2 pound of Granular Soil Conditioning Material & Fertilizer (per Section 329113 – Soil Preparation).
 - c. Add Mycorrhizal Inoculum to the excavated native soil, (per Section 329113 – Soil Preparation), per the Manufacturer's latest printed instructions.
 - 1) Pending the results of the Agronomic Soil Fertility Report, the Amended Planting Backfill Mixture may be modified accordingly to include additional soil amendments or fertilizers (gypsum, iron, potash, etc.) or the ratios as indicated in the Mixture indicated above may be modified.
 - a) The cost of providing modifications to the Amended Planting Soil Backfill Mixture (as recommended through the Agronomic Soil Fertility Report and as directed by the Landscape Architect) shall be borne by the Contractor.
 5. In areas indicated on the Contract Drawings, install the Deep Watering Bubblers as part of the irrigation system (per Section 328400 – Irrigation Systems).
 6. Install the Tree Root Aeration Unit(s) prior to backfilling operations, as required (per Section 329400 – Landscape Planting Accessories).
 7. Backfilling the excavated planting hole:
 - a. Place the Amended Planting Backfill Mixture around the root ball in the excavated planting hole. Place the Mixture in six-inch (6") lifts, tamping each lift accordingly to settle the Mixture and eliminate voids and air pockets.
 - b. Maintain the plant plumb while working the Mixture around the root ball. When the planting hole is approximately half-backfilled, water thoroughly before placing the remainder of the Mixture.
 - c. Add the Fertilizer Tablets and other amendments, as required, at the prescribed application rates indicated herein this Article or if not indicated, per the Manufacturer's instructions.
 - d. Place the final layers of the Mixture, tamping accordingly, to the top of the root ball. Do not place the Mixture on top of the root ball.
 - e. Dish and tamp top of the Mixture to form a three-inch (3") deep watering basin centered on the Plant Material's trunk to the rim width of the planting hole.. Do not cover the top of the root ball with the backfill mixture.
 - f. Thoroughly mix together water and Plant Vitamin/Hormone Stimulant in application ratio as recommended by Stimulant Manufacture (per Section 329400 – Landscape Planting Accessories). Apply liquid matrix in sufficient quantity to thoroughly saturate the basin to settle the Mixture, and to eliminate voids and air pockets. Should any portions of the root mass be exposed, add additional Mixture as needed to thoroughly cover the root mass.
 8. Mulching: Apply mulch in watering basins as indicated on the Contract Drawings. Refer to Section 329400 – Landscape Planting Accessories for type and requirements.

- E. Plant Settling and Orientation: Plant Material that has settled deeper than the surrounding grade shall be excavated and raised to the correct level, to the satisfaction of the Landscape Architect. Plant Material installed without direction and/or approval as to its proper orientation shall be subject to excavation and acceptable orientation, to the satisfaction of the Landscape Architect.
- F. Fertilizer Tablet(s) Application Rate: Refer to Section 329113 – Soil Preparation.

4. PLANTING GROUND COVERS, VINES, AND ESPALIERS

- A. General: Upon completion of applicable pre-planting soil preparation requirements indicated in Section 329113 – Soil Preparation, excavate planting hole(s) for Ground Covers and/or Vine Plant Material with scarified vertical sides, with the bottom of the excavated hole slightly raised and compacted at the center to assist drainage and to minimize settlement of the Plant Material. Refer to requirements indicated in Part III of this Section for Excavation.
 - 1. Plant Settling: Plant Material that has settled deeper than the surrounding grade shall be raised to the correct level.
- B. Excavate holes according to the spacing alignment (i.e. triangular spacing, etc.) and the on-center (O.C.) spacing intervals (i.e. 24" O.C. etc.) indicated on the Contract Drawings. Loosen any hard subsoil in the bottom of the excavation where evident, and remove all rocks greater than one-half-inch (1/2") in diameter, trash, debris, etc.
- C. Obstructions: Notify the Landscape Architect immediately if unexpected rock, debris, contaminants, obstructions, or other items that are detrimental to the healthy sustained growth of Plant Material is encountered in the excavation process.
- D. Ground Covers: Follow applicable planting requirements per Articles 3.02 and 3.03 indicated herein this Section.
 - 1. Carefully set root mass into excavated hole, spreading roots, and backfill with planting soil.
 - 2. Add Fertilizer Tablets and other amendments, as required, within backfill.
 - 3. Work soil around roots to eliminate air pockets, and provide a slight saucer indentation around plants to retain surface water.
 - 4. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

5. PRUNING PLANT MATERIAL

- A. At no time shall Plant Material be pruned, trimmed, thinned, shaped, or topped prior to delivery. Pruning, trimming, thinning, shaping, or topping of Plant Material shall be only conducted on the Project Site, and under the presence and direction of the Landscape Architect or approved Certified Arborist. Plant Material that has been pruned and delivered to the Project Site without prior approval by the Landscape Architect or an approved Certified Arborist will be rejected.
- B. When directed by the Landscape Architect or an approved Certified Arborist, Contractor shall prune, thin, and shape plant material, according to standard horticultural practice, to preserve the natural character of the Plant Material.
 - 1. Pruning and remedial work shall be done per ANSI A300.
 - 2. Prune trees to retain required height and spread. Do not cut tree leaders; remove only injured or dead branches from trees.
 - 3. Prune shrubs accordingly to retain natural character.

4. Provide pruning, cabling and bracing, irrigation, pest and disease control and other remedial treatments as recommended to assure the long-term health of the trees and existing vegetation, and the safety of persons and property.
5. Newly planted trees shall be pruned near the termination of the Landscape Establishment Period, per the direction of the Landscape Architect, as required.

6. CLEAN UP AND PROTECTION

- A. During installation operations, keep Work area in an orderly and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect landscaping from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, surplus soil and other items resulting from construction operations and legally dispose of it off the Owner's property.
- D. Scars, ruts, or other marks in the ground caused by the Contractor's Work shall be repaired.
- E. Remove equipment and implements of service, and leave the entire Project Site area in a neat, clean, and Owner-approved condition.
- F. Labels: Remove all nursery-type labels, flags, and or identification markings from Plant Materials.

7. FINAL REVIEW

- A. Final Review under this Section shall be performed upon completion of the Landscape Establishment Period. Refer to Section 329813 – Landscape Establishment Period, for requirements.

END OF SECTION

SECTION 32 94 00
PAVEMENT MARKING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation and field application of pavement marking on hot-mix asphalt paving and Portland cement concrete paving.

1.2 SUBMITTALS

- A. Refer to Section 01 33 00 – Submittal Procedures for submittal requirements.
- B. Product Data:
 - 1. Material List: Provide an inclusive list of required coating materials, including primers and other surface preparation materials. Indicate each material and cross-reference specific coating and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material proposed for use.
 - 3. Certification by the manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- C. Results of preconstruction field testing.

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of pavement marking material from one source and by a single manufacturer.
- B. Installer Qualifications: Engage an experienced installer who has completed pavement marking similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance of at least 5 years.
- C. Pre-Application Field Testing: Prepare a sample marking of each different paint formulation on asphalt substrates for the purpose of establishing quality of application, adherence of paint to the substrate, compatibility of the paint with the asphalt, and to determine whether a primer will be necessary if not otherwise required by the manufacturer.
 - 1. Minimum length of test stripe: 3 feet.
 - 2. Perform a minimum of 3 test stripes, located to provide a representative sample of entire area indicated to receive pavement marking paint.
 - 3. Apply test markings using methods and equipment recommended by the manufacturer of the marking paint and as specified in this Section.
 - 4. Arrange for a technical representative of the marking paint manufacturer to observe cured test samples and provide written recommendations for changes, if any, to materials or methods necessary to achieve optimum paint performance on specific substrates.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.
- B. Store pavement-marking materials in a clean, dry, protected location and within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.5 PROJECT CONDITIONS

- A. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 50 deg F, and not exceeding 90 deg F.

PART 2 - PRODUCTS

2.1 PAVEMENT MARKING MATERIALS

- A. Pavement-Marking Paint: Lead free latex, water-base emulsion, ready-mixed, complying with FS TT-P-1952, and suitable for use on both hot-mix asphalt and Portland cement concrete paving. Provide material having a volatile organic compound (VOC) content of 250 g/L, or less.
 - 1. Colors:
 - a. Color: White (for all parking stalls other than disabled access parking, for traffic and lane marking, and for painted text).
 - b. Color: Yellow, where indicated.
 - c. Color: Red (for "No Parking" areas as shown).
 - d. Color: Blue (for pavement markings identifying disabled access parking).
 - 2. Gloss: Flat or eggshell with gloss at 30 percent or less when measured at a 60-degree meter.
- B. Primer: Type recommended by the marking paint manufacturer.
- C. Surface Cleaning Material: Cleaning agent or agents suitable for removing grease, oil, and other contaminants that will not damage asphalt or Portland cement concrete paving and are acceptable to pavement marking paint manufacturer.

PART 3 - EXECUTION

3.1 PAVEMENT MARKING

- A. Allow paving to cure for a minimum of 30 days before starting pavement marking. Comply with recommendations of the pavement marking paint manufacturer for longer cure periods.
- B. Sweep and clean surface to eliminate loose material and dust. Ensure all surfaces indicated to receive pavement marking are clean and free from grease, oil, concrete sealers and curing agents, and other contaminants that might interfere with paint adhesion.

1. Comply with manufacturer's instructions for use of special cleaning agents.
 2. For removal of substances that would interfere with paint adhesion use methods recommended by the paint manufacturer if applicable, or methods that will completely remove the substance without damaging or discoloring the underlying pavement substrate.
- C. Apply paint with mechanical equipment to produce pavement markings of dimensions indicated with uniform, straight edges. Apply at manufacturer's recommended rates based on substrate type and cure conditions to provide a minimum wet film thickness of 15 mils and dry film thickness of 8 mils, unless otherwise recommended by the manufacturer.
- D. Comply with paint manufacturer's maximum recommended drying time before allowing traffic in order to prevent undue softening of bitumen and pick-up, displacement, or discoloration of pavement marking by vehicular traffic.
- E. Paint pavement, curbs, and other surfaces as shown on the Drawings. Painting shall be straight, uniform, exact, and sharp without blobs at the start and finish. Edges shall be even, accurate, symmetrical, and free of fuzziness.
1. Edge Tolerance: 1/2 inch in 20 feet, maximum.
- F. Apply markings for disabled access symbols in accordance with State of California Building Code, Part 2, Title 24, California Building Standards.
- G. Where work consists of modifications of, or additions to existing pavement marking, match existing color and line width.

3.2 ADJUSTING

- A. Touch up pavement markings not complying with requirements of this Section by painting out the errors with permanently opaque paint of the same color as the substrate pavement.
1. Block out and eliminate all traces of splashed, tracked, and spilled pavement marking paint from the background surfaces.
 2. Paint over deviations in marking edges exceeding allowable tolerance and apply new marking meeting specified requirements.
- B. The Owner reserves the right to require sandblast removal of extensive defective pavement marking and application of new marking meeting specified requirements at no additional cost.

3.3 PROTECTION

- A. Provide traffic cones, barricades, and other devices needed to protect the pavement marking until it is sufficiently dry to withstand traffic without damage.

3.4 STANDARD PLANS

- A. The following Standard Plans have been specified on the Drawings and are included following this Section for Contractor's convenience:
1. California Department of Transportation Standard Plan A24A "Pavement Markings Arrows" (1 sheet)

2. California Department of Transportation Standard Plan A24D "Pavement Markings Words" (1 sheet)

END OF SECTION

SECTION 329410 – LANDSCAPE PLANTING ACCESSORIES

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete exterior Landscape Planting Accessories installation, as shown in the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Mulches (wood products).
 - 2. Tree Root Aeration Units (a.k.a. Tree Chimney's).
 - 3. Root Control Barriers.
 - 4. Stakes and Guys.
 - 5. Erosion Control Materials.
 - 6. Landscape Edgings (Headers/Edgings).
 - 7. Weed Control Barrier / Geotextile Filter Fabric.
 - 8. Miscellaneous Materials (Herbicides, Vitamin Stimulant/Root Hormone, etc.).
- C. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 312219 – Landscape Grading.
 - 2. Section 321500 – Aggregate Surfacing.
 - 3. Section 321313 – Concrete Paving.
 - 4. Section 321323 – Site Concrete.
 - 5. Section 328400 – Irrigation Systems.
 - 6. Section 329113 – Soil Preparation.
 - 7. Section 329200 – Lawns & Grasses.
 - 8. Section 329300 – Exterior Plants.
 - 9. Section 329813 – Landscape Establishment Period.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
- B. Definitions: (Not Used).
- C. Measurements:
 - 1. PSI: Measurement, in pounds per square inch.
 - 2. CU/FT: Measurement, in cubic-foot.
 - 3. PPM: Measurement, in parts per million.

3. SUBMITTALS

- A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
 2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
 3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.
- B. Digital Submittal Information:
1. Product/Material Data. Submit available product/material literature supplied by manufacturer's, indicating that their products comply with specified requirements. Provide manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of product/material.
 2. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Landscape Planting Accessories installations.
- C. Material Samples: Submit four (4) sets of physical Material Samples for review of kind, color, pattern, size, and texture for a check of these characteristics with other elements, and for a comparison of these characteristics between Submittal and actual component as delivered and installed. Include the full range of exposed color and texture expected in the completed Work. Provide Material Samples bound and individually wrapped in re-sealable labeled 1-gallon plastic bags (as applicable):
1. 0.50 cubic foot of Landscape Mulch Material (Shredded Wood Mulch).
 2. One (1) two-foot (2'-0") long section of Tree Root Aeration Unit assembly.
 3. One (1) two-foot (2'-0") long sample of Root Control Barrier.
 4. One (1) set of Tree Tying/Staking Materials for each type used, as applicable.
 5. One (1) set of Tree Guying Materials for each type used, as applicable.
 6. One (1) two-foot (2'-0") length of Vine Support Tape, and one (1) Vine Support Anchor, as applicable.
 7. One (1) two-foot (2'-0") square sample of Erosion Control Material for each type used, as applicable.
 8. One (1) two-foot (2'-0") sample of Landscape Edging Materials and Accessories (stake, etc), to verify gauge, size, and color selected, as applicable.
 9. One (1) two-foot (2'-0") square sample of Weed Control Barrier / Geotextile Filter Fabric for each type used, as applicable.
- D. Scaled Shop Drawings: Not Required.
- E. Field-Constructed Mock-ups: Not Required.
- F. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- G. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.
4. QUALITY ASSURANCE AND CONTROL

- A. Installer Qualifications:
 - 1. Requirement: Valid **California** C-27 (Landscaping Contractor) License.
 - 2. Engage an experienced Installer who has completed Landscape Planting Accessories work similar in material, design, and extent to that indicated for this Project and with a record of successful installation.
 - 3. Installer's Field Supervision: Installer shall maintain an experienced full-time supervisor on the Project site during times that installations under this Section are in progress.
- B. Observation: Landscape Architect may observe installation of Landscape Planting Accessories at Project Site for compliance with requirements for type, size, and quality. Landscape Architect retains right to observe Landscape Planting Accessories for defects and to reject unsatisfactory or defective material at any time during progress of Work. Contractor shall remove rejected Accessories immediately from Project site.
- C. Manufacturer's Directions: Follow Manufacturer's directions and drawings in cases where the Manufacturers of articles used in this Section furnish directions covering points not shown in the Contract Drawings and Contract Specifications.
- D. Permits, Fees, Bonds, and Inspections: Contractor shall arrange and pay for permits, fees, bonds, testing services, and inspections necessary to perform and complete Work under this Section.
- E. Single-Source Responsibility: Obtain each color, type, and variety of products/materials from a single source with resources to provide products/materials of consistent quality in appearance and physical properties without delaying Work.

5. DELIVERY, STORAGE, AND HANDLING

- A. Provide new, unused materials indicated under this Section. Store and secure properly to prevent theft or damage. Deliver and store perishable material in original, unopened packaging. It is the responsibility of the Contractor to install "factory condition" Units.
- B. Damaged Materials: Be responsible for all damage or disfiguration of Work until Final Acceptance. Remove off site and replace at no additional cost to Owner all damaged or rejected materials.
- C. Deliver materials so as to not delay Work, and install only after preparations for installation have been completed.

6. COORDINATION, SCHEDULING, AND OBSERVATIONS

- A. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
- B. Excavation: When conditions detrimental to installing Landscape Planting Accessories are encountered, such as rubble fill, adverse drainage conditions, or obstructions, cease installation operations and notify Landscape Architect for further direction.
- C. Field Measurements: Contractor shall take field measurements as required. Report major discrepancies between the Contract Drawings and field dimensions to the Landscape Architect prior to commencing Work.

- D. Installation: Perform installation of Landscape Planting Accessories only when weather and soil conditions are suitable in accordance with locally accepted practices.
- E. Construction Site Observations: Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.

7. SUBSTITUTIONS

- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
- B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
- C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
- D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

8. LANDSCAPE ESTABLISHMENT PERIOD

- A. Refer to Section 329813 – Landscape Establishment Period, for requirements under this Article.
 - 1. During the duration of the Landscape Establishment Period, continuously maintain Landscape Planting Accessories by tightening, holding plumb, and/or repairing Staking and/or Guying supports, providing adequate depths and coverage requirements of Landscape Mulching Materials, monitoring drainage within Tree Root Aeration Units, hold Edging Materials true and in proper alignments, and other requirements, as required, to establish healthy, viable landscape planting materials until Final Acceptance of Work is granted.

2.PRODUCTS

1. LANDSCAPE MULCH MATERIALS

- A. Gravel Mulch: Per Contract Documents.
- B. Shredded Wood Mulch: Shredded Wood Mulch, free from deleterious materials, debris, and weed seed. Suitable as a top dressing of trees, shrubs and groundcovers, consisting of following:
 - 1. Type: Shredded cedar, redwood, fir, or hardwood commercial wood bark products, composted with humus and leaf materials. Shredded Wood Mulch shall be graded and to

average dimensions of one-inch (1") to three-inches (3") in length, and flat in cross-section.

- a. Minimum organic matter content at 80%.
- b. pH between 5.0 and 8.0.
- c. Salt content shall be less than 4 millimho/cm @ 25 ° C. on a saturated paste extract.
- d. Boron content of the saturated extract shall be less than 1.0 parts per million.
- e. Calcium carbonate shall not be present.
- f. Carbon:Nitrogen ratio is less than 100:1.
- g. Compost shall be aerobic without malodorous presence of decomposition products.
- h. Maximum particle size shall be 2 inches. A maximum of 5% shall pass a No. 2 screen.

<i>Maximum Total Permissible Pollutant Concentrations (in parts per million (PPM)) on a dry weight basis:</i>	
Arsenic	20 ppm
Molybdenum	30 ppm
Cadmium	15 ppm
Nickel	50 ppm
Chromium	150 ppm
Selenium	25 ppm
Cobalt	50 ppm
Silver	10 ppm
Copper	150 ppm
Vanadium	50 ppm
Lead	150 ppm
Zinc	150 ppm
Mercury	10 ppm

2. Coverage Depth:
 - a. Refer to Part III indicated herein this Section.
3. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *ES-2 Mulch*, Agromin Horticultural Products.
 - b. *Pacific Mulch™*, Greenways Environmental.
 - c. *Walk-On Chips*, Earthworks Soil Amendments, Inc.
 - d. *Landscape Mulch*, Agri Service, Inc.
 - e. *Red Fir Bark*, Greenway Compost.
 - f. *A-1 Oak Deco Chips*, Hanson Aggregates/A-1 Soils.
 - g. *#SBM 3, Special Mulch #3*, Plants Choice, Inc.
 - h. Or equal, as approved by the Landscape Architect.

2. TREE ROOT AERATION UNITS (TREE CHIMNEY'S)

- A. General: Tree Root Aeration Units are a complete assembly, consisting of a perforated Aeration Pipe Tube, wrapped in Geo-textile Filter Fabric sleeving, and topped with a Grate.
- B. Aeration Pipe Tube: Manufactured from high-density polyethylene (HDPE) resin, meeting ASTM F810. Pipe shall be perforated with machine-drilled holes, set either with 3/8" holes on 4" centers at 120 degrees, or on-half-inch (1/2") holes on five-inch (5") centers at one-hundred-twenty (120) degrees.
1. Length: As required, per Contract Drawings.
 2. Size (Diameter): <<<SELECT ONE>>>
 - a. 3" diameter Pipe.
 - b. 4" diameter Pipe.
 - c. 6" diameter Pipe.
 3. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. 3000 Triple Wall Drainage Pipe, ADS.
 - b. Perforated SDR35 Solvent Weld Underdrain Pipe, P.W. Eagle.
 - c. COEX, PSP.
 - d. Big "O" Drainage Tubing, Armtec.
 - e. Or equal, as approved by the Landscape Architect.
- C. Geo-textile Filter Fabric Sleeving for Aeration Pipe Tube: Meet ASTM D6707. Permeable, lightweight, continuous, non-woven, UV resistant, synthetic geo-textile (nylon or polyester) filament material, engineered to allow water permeability and deter soil permittivity, per ASTM D4491. Fabric shall be non-biodegradable, resistant to acids and alkalis, and sized accordingly.
1. Length: As required, per length of Aeration Pipe.
 2. Size: As required, to sleeve (snugly fit) over the diameter of the specified Aeration Pipe tube.
 3. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Drain Sock, ADS.
 - b. Drain-Sleeve Filter Fabric, Carriff Corporation.
 - c. Filter Fabric, Zodiac Fabrics, Inc.
 - d. Big "O" Sock Filter, Armtec.
 - e. Drain-Eez, Christy's.
 - f. Or equal, as approved by the Landscape Architect.
- D. Aeration Pipe Grates (sized accordingly to fit snugly to the specified Aeration Pipe Tube).
1. Shrub and Groundcover Areas: Atrium-type Grate.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) 3" Atrium Grate #74S (sand color), National Diversified Sales (NDS), Camarillo, CA.
 - 2) 4" Atrium Grate #78S (sand color), National Diversified Sales (NDS), Camarillo, CA.
 - 3) 6" Atrium Grate #90S (sand color), National Diversified Sales (NDS), Camarillo, CA.
 - 4) Or equal, as approved by the Landscape Architect.
 2. Lawn Areas: Flat-type Grate, round in shape.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following: <<<Select Size, equal to Pipe Size>>>
 - 1) 3" Round Grate #16 (green color), National Diversified Sales (NDS), Camarillo, CA.

- 2) *4" Round Grate #13 (green color)*, National Diversified Sales (NDS), Camarillo, CA.
- 3) *6" Round Grate #50 (green color)*, National Diversified Sales (NDS), Camarillo, CA.
- 4) Or equal, as approved by the Landscape Architect.

3. ROOT CONTROL BARRIERS

A. Plastic Root Control Barrier:

1. General: Plastic Root Control Barrier shall be a long-term root control system for trees, fully permeable to oxygen and water to sustain and direct plant growth. Plastic Root Control Barrier shall be manufactured of an extruded, high-impact black homo-polymer (polyethylene or polyolefin) plastic, with minimum 50% post-consumer recycled material, and UV inhibitors. Plastic Root Control Barrier shall be composed of a system consisting of a series of integrally-molded, self-interlocking Barrier Panels. Polystyrene-based plastic is unacceptable.
 - a. Size: Each panel shall be a minimum of twenty-four-inches (24") in width and thirty-six-inches (36") in depth, extruded to a mean thickness of minimum .08 inches, with 1/2" to 3/4" raised vertical ribs running perpendicular to the panel and spaced six-inches (6") on-center. Provide quantity as required of integrated interlocking joint panels, in lengths as required.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *UB-36-2 Deep Root*, Deep Root Partners, San Francisco, CA, 800-458-7668.
 - 2) *Root Solutions*, Vespro, Inc., San Rafael, CA, 800-554-0914.
 - 3) *Dual Purpose Panels, .085 Thickness*, Villa Root Barrier, Inc. Lake Elsinore, CA, 800-654-4067.
 - 4) *RP Series Root Barrier Panel*, NDS, 800-726-1994.
 - 5) *CP Series Root Barrier Panel*, Century Products USA, 714-632-7083.
 - 6) Or equal, as approved by the Landscape Architect.

4. STAKES AND GUYS

A. Tree Staking Assembly:

1. Wooden Stake Tree Staking Assembly: Complete tree staking Unit, consisting of Lodge Pole Pine Tree Stakes with (*choose one: Tree Ties/Tree Straps/Twist Braces*)
 - a. Tree Stakes: Lodge Pole Pine Wooden Tree Stake, straight shaft, shaved and cut, cleaned and bare of branches and stubs, free of loose knots, bends, splits, or bows, of uniform thickness, with a minimum diameter of either two-inches (2") or two-one-half (2-1/2") to three-inches (3"). Lengths shall be eight-feet (8'), ten-feet (10') or twelve-feet (12'), as required, to adequately and firmly penetrate the sub grade and support the tree. Stake shall have a minimum ten-inch (10") long tapered/conical driving point, and chamfered top to minimize splitting when driven. Stake shall be pressure treated (per Federal Specification TT-W-00571-J-Table 2) with an EPA-registered pesticide containing inorganic arsenic (copper chromium arsenate, meeting Federal Specification TT-W-550-Type 1) to protect it from insect attack and decay.
 - 1) Quantity, Size, and Length per tree:
 - a) #5 container stock: One (1), two-inch (2") diameter, eight-foot (8') long or ten-foot (10') long (as required) Wooden Tree Stake per tree, (*Where Twist Braces are used, provide two (2) Wooden Tree Stakes*).

- b) #15 container stock: One (1), two-inch (2") diameter, 10'-0" long or 12'-0" long (as required) Wooden Tree Stake per tree. *(Where Twist Braces are used, provide two (2) Wooden Tree Stakes).*
- c) 24" box container stock: Two (2) Two-inch (2") diameter, ten-foot (10') long or twelve-foot (12') long (as required) Wooden Tree Stakes per tree.
- d) >24" box container stock: Minimum two (2) two-one-half-inches (2-1/2") or three-inches (3") diameter, ten-foot (10') or twelve-foot (12') long (as required) Wooden Tree Stakes per tree.
- 2) Special Circumstances: Should lengths of Wooden Tree Stakes be inadequate to satisfactorily support the tree being staked in an upright, plumb condition, Contractor shall provide Metal Stake Tree Staking Assembly as indicated herein this Article.
- 3) Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) Sullivan & Mann Lumber Company, Tustin, CA.
 - b) BVC Tree Stakes.
 - c) TruStakes, 4Seasons Wood Products.
 - d) Or equal, as approved by the Landscape Architect.
- b. Tree Ties: Flexible, non-deteriorating, UV-resistant, self-fastening, black vinyl Tree Tie, meeting ASTM D412 for tensile and elongation strength, in the lengths and sizes as indicated, to adequately support the tree to the Wooden Tree Stake.
 - 1) Quantity, Size, and Length per tree:
 - a) #5 container stock: #CT-18 (18" length). Provide two (2) Tree Ties minimum for each Tree Stake.
 - b) #15 container stock: #CT-24 (24" length). Provide two (2) Tree Ties minimum for each Tree Stake.
 - c) 24" box container stock and larger: #CT-32 (32" length). Provide two (2) Tree Ties minimum for each Tree Stake.
 - d) In special staking applications where Tree Ties need to be longer than 32" in length, attach two (2) 32" long Tree Ties together as recommended by the Manufacturer to make a single Tree Tie.
 - 2) Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) Cinch-Ties™, V.I.T. Products, Inc., Escondido, CA.
 - b) E-Z Band, Villa Landscape Products, Lake Elsinore, CA
 - c) Or equal, as approved by the Landscape Architect.
 - 3) Tree Tie Nails: Galvanized steel roofing nails, one-one-half-inches (1-1/2") in length. Use nails in sufficient quantity to securely attach the Tree Ties to Tree Stakes.
- c. **Tree Straps:** Non-stretch, biodegradable cotton, dyed dark-green color, one-inch (1") wide x eighteen-inches (18") long, with one-inch (1") brass grommets at each end. Break strength at 260 lbs. nominal.
 - 1) Quantity, Size, and Length per tree:
 - a) #5 container stock: Provide two (2) Tree Straps minimum for each Tree Stake provided.
 - b) #15 container stock: Provide two (2) Tree Straps minimum for each Tree Stake provided.
 - c) 24" box container stock and larger: Provide two (2) Tree Straps minimum for each set of Tree Stakes provided.
 - 2) Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) #3718 Biodegradable Original Treestrap®, GCS.

- b) Or equal (no known equal).
 - 3) Tree Strap Wire: Smooth, galvanized annealed Steel Wire, 12 gauge. Provide Wire in adequate lengths to anchor the grommet ends of the Tree Straps to the Tree Stakes.
 - d. **Twist Braces:** Single assembly of 5/16" diameter round metal rod, twisted with a minimum 4-1/2" loop, with steel bar stock brackets welded on both ends, Round metal rod shall be encased in black vinyl UV-resistant tubing, in the lengths and sizes as indicated, to adequately support the tree to the Tree Stakes.
 - 1) Quantity, Size, and Length per tree:
 - a) #5 to #15 container stock: #TB-18 (18" length, 4-1/2" loop). Provide one (1) Twist Brace minimum and two (2) Wooden Tree Stakes.
 - b) 24" box container stock: #TB-24 (24" length, 4-1/2" loop). Provide one (1) Twist Brace minimum for each set of Tree Stakes.
 - c) 36" box container stock: #TB-36 (36" length, 4-1/2" loop). Provide one (1) Twist Brace minimum for each set of Tree Stakes. Verify if tree caliper can accommodate the Twist Tie loop; if inadequate, provide next larger size.
 - d) 42" box container stock: #TB-42 (42" length, 7-1/2" loop). Provide one (1) Twist Brace minimum for each set of Tree Stakes. Verify if tree caliper can accommodate the Twist Tie loop; if inadequate, provide Tree Guy assembly.
 - 2) Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Twist-Brace*™, V.I.T. Products, Inc., Escondido, CA.
 - b) Or equal (no known equal).
 - 3) Twist Brace Hardware: Galvanized steel Wood Screws, #10 x 1-1/2" in length. Provide hardware in sufficient quantity to securely attach each Twist Brace to Tree Stakes.
 - 2. Metal Stake Tree Staking Assembly: Complete tree staking Unit, consisting of Metal Tree Stakes, Tree Straps, and Tree Strap Wire (as required).
 - a. General: Metal Stake Tree Staking Assembly shall be provided in special circumstances when the use of Wooden Tree Stakes is inadequate to satisfactorily support the tree being staked in an upright, plumb condition (possibly due to high wind conditions, sandy soils, tree height is excessive, wooden stakes are too short, etc.).
 - b. Metal Tree Stakes: Galvanized Steel Schedule 40 pipe, in the diameter indicated herein this Article. Stake(s) shall be driven into the sub grade soil at the minimum length as indicated in the Contract Drawings, with the total length for each Stake provided per the requirements indicated herein this Article. Stake(s) shall have a cut & tapered driving point and top shall be clean cut and free from burrs. Stake(s) shall be straight and true, free from bends or bows. Stake(s) shall have a 1/2" diameter hole drilled through the Stake to provide anchorage of the Tree Straps and Tree Strap Wires. Holes shall be drilled no less than 4" above the top of the Stake. Stake(s) shall be primed and painted with two (2) coats of flat black enamel paint.
 - 1) Quantity, Size, and Length per tree:
 - a) #5 container stock: One (1), 3/4" diameter, 8'-0" long Metal Tree Stake per tree, or in length required to firmly support the tree above the finished grade, not-to-exceed 3/4" of the tree's height.
 - b) #15 container stock: One (1), 1-1/2" diameter, 10'-0" long Metal Tree Stake per tree, or in length as required to firmly support the tree above the finished grade, not-to-exceed 3/4" of the tree's height.

- c) 24" box container stock: Two (2), 2" diameter, 12'-0" long Metal Tree Stakes per tree, or in lengths as required to firmly support the tree above the finished grade, not-to-exceed $\frac{3}{4}$ " of the tree's height.
 - d) 36" box and larger container stock, to 3" caliper: Two (2), 2" diameter, 15'-0" long Metal Tree Stakes per tree, or in lengths as required to firmly support the tree above the finished grade, not-to-exceed $\frac{3}{4}$ " of the tree's height.
 - c. Tree Straps and Tree Strap Wire: Refer to requirements indicated herein this Article.
 - 3. **Metal T-Bar Type Tree Staking Assembly:** Complete tree staking Unit, consisting of a screw-in auger-type steel Stake, with adjustable height T-bar or strap bar, UV resistant vinyl tubing and cable ties, anti-rotational tab and pin, and Manufacturer-applied powder-coat finish.
 - a. For trees to 24" box and smaller, use 9'-0", $\frac{3}{4}$ " diameter, Schedule 40. steel Stake system.
 - b. For trees 30" box to 48" box, use 11'-0", 1-3/4" diameter, Schedule 40 steel Stake system.
 - c. Stake color: <
 - 1) Manufacturer-applied Dark Green powder coat finish.
 - 2) Manufacturer-applied Black powder coat finish.
 - d. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Reddy-Stake/Mega Stake System*, Reddy Stake, 888-333-3090.
 - 2) Or equal (no known equal).
- B. Tree Guying Hardware
- 1. Tree Support Guying System (above-grade application):
 - a. Pre-assembled, pre-packaged, tree anchoring system, specifically manufactured to anchor trees in a primary above-grade application. System components (sized accordingly to tree caliper) include anchors, vinyl coated wire rope **wire rope**), turn buckles, tree collars, and wire rope clamps.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Duckbill Tree Anchor System*, Foresight Products, LLC, 6430 E. 49th Drive, Commerce City, CO 80022, 800-325-5360.
 - 2) Or equal (no known equal).
 - c. Product Application:
 - 1) For trees up to 3" caliper, Duckbill Tree Anchor System #40DTS.
 - 2) For trees up to 6" caliper, Duckbill Tree Anchor System #68DTS.
 - 3) For trees up to 11" caliper, Duckbill Tree Anchor System #88DTS.
 - 2. Tree Support Root Guying System (complete below grade application).
 - a. Pre-assembled, pre-packaged, tree anchoring system, specifically designed and manufactured to hold the tree's root ball in place, with only the tree protruding from the ground. System components (sized accordingly to tree caliper) include anchors, wire rope, turn buckles, tree collars, and wire rope clamps.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Duckbill Tree Anchor System*, Foresight Products, LLC, 6430 E. 49th Drive, Commerce City, CO 80022, 800-325-5360.
 - 2) Or equal (no known equal).
 - c. Product Application:
 - 1) For trees up to 3" caliper, Duckbill Tree Anchor System #68RBK.
 - 2) For trees up to 6" caliper, Duckbill Tree Anchor System #88RBK.

3. Sub-Surface Suspender Guying System (complete below grade guying system for on-structure applications).
 - a. General: Provide suspender materials when installation of palms or trees are on-structure or the installation does not permit sufficient depth for installation to guarantee maintenance of trunk in a plumb condition throughout the Warranty Period.
 - b. Concrete Slab: Slab with embedded reinforcement tie bars. Slabs shall be installed as indicated on the Contract Drawings.
 - 1) Concrete Mix Design:
 - a) Minimum Compressive strength at 28 days: 3,500 psi.
 - b) Slump: 4" to 6".
 - c) Maximum Water/Cement Ratio: .50.
 - c. Suspender Strap Reinforcing Hardware:
 - 1) General: Brown, High tenacity 40mm wide polyester strapping. with minimum burst strength of 8,500 pounds.
 - 2) Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Cordstrap CC150*, Cordstrap, Inc., Issaquah, WA 916.420.8296.
 - b) Or equal (no known equal).
 - d. Suspender Strap Tensioner:
 - 1) General: All-in-one pneumatic, buckling, cutting, gripping, and crimping tool.
 - 2) Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a) *Cordstrap CT50*, Cordstrap, Inc., Issaquah, WA 916.420.8296.
 - b) Or equal (no known equal).
 - e. Rebar Tie Rods: ASTM A615, Grade 40, or 60 deformed billet steel bar, epoxy coated for marine environment.
 - f. Strapping Frame: 2 x 4 PTDF or marine-grade wood.

5. EROSION CONTROL MATERIALS

- B. **Open Weave Jute Fiber Mesh:** Biodegradable, woven, 100% natural jute fiber yarn, +/- 0.25" thick, un-dyed and unbleached, 0.92 lbs. per sq. yd. minimum, with 50% to 65% open area. Provide "U"-shaped, 11-gauge steel wire staples, six-inches (6") to eight-inches (8") long, 2" crown, to anchor Jute Fiber Mesh to soil surface.
 1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Anti-Wash/Geojute*, Belton Industries, Inc.
 - b. Or equal, as approved by the Landscape Architect.
 2. Provide on slope gradients 4:1 and greater

6. LANDSCAPE EDGINGS/HEADERS/MOWSTRIPS

- A. Steel Edging/Header:
 1. General: Steel Edging/Header shall be in the location and size as shown on the Contract Drawings. Comply with ASTM A569, hot-rolled, standard flexible carbon steel edging, fabricated in sections with stake pockets stamped, punched, or welded to face of sections approximately thirty inches (30") apart to receive stakes. Steel Edging/Header shall be double-staked at overlap joints, and designed to receive tapered steel stakes.
 - a. Size: 1/4" thick, 5" wide, by 16'-0" length, with seven (7) stakes per 16' section.

- b. Color/Finish: Factory-applied Sherwin Williams H68GT85 powder coat paint, electrostatically applied and oven baked. Minimum thickness to be 1.5 mils.
 - 1) Color: Black.
 - c. Color/Finish: Factory-applied dipped galvanized finish, applied after steel landscape edging is cut to length and stake pockets are stamped, punched or welded. Galvanization shall comply with ASTM A123. Zinc coverage shall be to a standard thickness of 3.3 mil (2.0 oz/ft²).
 2. Steel Edging/Header Stakes: Steel, tapered, 15-16" minimum length, finish to match specified Steel Edging/Header. Stakes designed specifically to anchor Steel Edging/Header in place, and manufactured by manufacturer of the Steel Edging/Header for which they will be used.
 3. Accessories: Standard tapered ends, corners, and splices, as required.
 4. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *DuraEdge®*, J.D. Russell Co., Tucson, AZ.
 - b. Or equal, as approved by the Landscape Architect.
7. WEED CONTROL BARRIER/GEO-TEXTILE FILTER FABRIC
 - A. Type: Permeable, lightweight, continuous, non-woven, geo-textile polypropylene filament material, UV-resistant, engineered to allow water permeability and deter soil permittivity, per ASTM D4491. Geo-Textile Filter Fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis and acids. Meet AASHTO M288-96, Class 1.
 - B. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 1. *Amoco 4553*, Amoco Fabrics and Fibers Company.
 2. *FX-80HS*, Carthage Mills.
 3. *C-80NW*, Contech.
 4. *180 EX*, Linq.
 5. *Geotex 801*, Propex, Inc.
 6. *TerraTex N08*, Webtec.
 7. *180N*, TC Mirafi.
 8. *3301*, Typar Landscape Products.
 9. Or equal, as approved by the Landscape Architect.
8. MISCELLANEOUS MATERIALS
 - A. Water: Per ASTM C94, from potable domestic source, and free from deleterious materials such as oils, acids, and organic matter. Transport as required.
 - B. Stress Reducing Agent: 100% natural organic root and plant stimulator solution, used to eliminate transplant shock and provide better establishment of plants. Solution shall contain a natural wetting agent, designed to improve nutrient release, water-holding capacity, cation exchange capacity in soil, and stimulate fertilizer and micronutrient uptake.
 1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Roots NoBurn®*, Novozymes Biologicals, Inc., Salem, VA.
 - b. *Essential® Plus 1-0-1*, Growth Products, White Plains, NY.
 2. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations.

- C. Wetting Agent and Soil Penetrant (Surfactant): Highly-concentrated liquid solution. Provide in a diluted liquid solution, mixed with water, at the time of watering-in recently planted plant species.
1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Roots NoBurn®*, Novozymes Biologicals, Inc., Salem, VA.
 - b. *LESCO-Wet™ Plus*, Lescro, Inc., Cleveland, OH.
 - c. *Naiad Liquid Wetting Agent*, Naiad Company, Inc., Stockton, CA.
 - d. *Aqua-Gro L*, Scotts Company, Marysville, OH.
 - e. *Sixteen-90*, Aquatrols, Cherry Hills, NJ.
 - f. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
- D. Plant Vitamin/Hormone Stimulant: Highly-concentrated liquid vitamin solution. Provide in a diluted liquid solution, mixed with water, at the time of watering-in recently planted plant species.
1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *SUPERthrive*, Vitamin Institute.
 - b. *Roots Concentrate Rooting Stimulant*, Novozymes Biologicals, Inc.
 - c. *Root-Maxx Plus*, Bio-Plex.
 - d. Or equal, as approved by the Landscape Architect.
 2. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
- E. Herbicides: EPA registered and approved, from the following:
1. Non-Selective Post-Emergent Herbicide: Spray-applied solution containing a minimum of 41% of the active ingredient "glyphosate" (full strength), with a surfactant, mixed with water accordingly per the Manufacturer's directions.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Roundup® PRO*, (41% glyphosate), Monsanto Company.
 - 2) *Roundup® PROmax* (concentrate, 50% glyphosate), Monsanto Company.
 - 3) *Honcho® Plus*, (41% glyphosate), Monsanto Company.
 - 4) *Prosecutor* (41% glyphosate), LESCO, Inc.
 - 5) *High Yield® Kill-Zall Weed & Grass Killer*, (41% glyphosate), Voluntary Purchasing Groups.
 - 6) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
 2. Selective Pre-Emergent Herbicide (Packaged dry material application): Pre-emergent control of annual grasses and broadleaf weeds in turf grass areas, and woody ornamental trees, shrubs, vines, and groundcover areas.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Ronstar® 2G*, (granular), Aventis Environmental Science USA.
 - 2) *Snapshot® 2.5 GT* (granular), (2% trifluralin), Dow AgroSciences LLC.
 - 3) *XL*2G*, SETRE Chemical Company.
 - 4) *Casoron 4G*, Chemtura.
 - 5) *Treflan® HFP* (43% trifluralin), Dow AgroSciences LLC.
 - 6) *Treflan® TR-10*, (10% Granular trifluralin), Dow AgroSciences LLC.
 - 7) *Surflan®*, Dow AgroSciences, LLC.
 - 8) Or equal, as approved by the Landscape Architect.

- b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.
- 3. Selective Post-Emergent Herbicide: Pre-mixed, flow-able formulation designed for product stability, uniformity in the spray solution and ease of handling. Post-emergent control of annual grasses, nutsedge, and broadleaf weeds in turf, generally with one (1) application.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) *Trimec® Plus*, PBI/Gordon Corporation.
 - 2) *Three-Way*, LESCO, Inc.
 - 3) Or equal, as approved by the Landscape Architect.
 - b. Application Rate: Provide at prescribed rate and application per Manufacturer's written recommendations, per one-hundred (100) gallons of water.

3.EXECUTION

1. GENERAL

- A. Installation practices of the Landscape Planting Accessories shall be performed during those periods when weather and soil conditions are suitable and in accordance with locally accepted horticultural practice, as approved by the Landscape Architect. Contractor shall notify the Landscape Architect, in writing, on the anticipated commencement date and length of duration of the landscape installation.
- B. Examination: Examine areas to receive landscaping for compliance with requirements and for conditions affecting performance of Work of this Section. NO WORK UNDER THIS SECTION SHALL COMMENCE UNTIL ALL SUBMITTALS UNDER THIS SECTION HAVE BEEN REVIEWED AND APPROVED, IN WRITING. DO NOT PROCEED WITH INSTALLATION UNTIL UNSATISFACTORY CONDITIONS HAVE BEEN CORRECTED.
- C. Prior to Work in this Section, Contractor shall examine previously installed Work from other trades and verify that such Work is complete and as required, to the point where the installation of the Landscape Planting Accessories may commence properly.

2. PROTECTION OF SITE

- A. Contractor shall protect existing and new improvements and systems installed prior to installation of Landscape Planting Accessories. Maintain protection in place until completion of Work and Landscape Establishment Period.

3. INSTALLATION OF TREE ROOT AERATION UNITS (TREE CHIMNEY'S)

- A. General: Tree Root Aeration Unit(s) shall be installed after excavation of planting hole and prior to placement of Amended Planting Backfill Mixture.
- B. Upon completion of excavation of planting hole, auger a twelve-inch (12") diameter hole at the edge of the excavation. Depth shall extend two-feet (2') beyond the compacted setting layer crown of native planting soil. Remove excess soil.

- C. Pipe Installation: Slide Geo-Textile Filter Fabric Sleeve over full length of Perforated Aeration Pipe Tube. Secure open end (as set in bottom of hole) of Filter Fabric Sleeve with a knot or pipe wrap tape. Place assembly Unit plumb, in vertical position, in the bottom of the augered hole. Set the top of the Unit ½" above the finished surface elevation of the mulch layer.
- D. Set Plant Material accordingly, and backfill the planting hole with Amended Planting Backfill Mixture, being careful not to provide backfill within the inside of the Tree Root Aeration Unit assembly.
- E. Attach Aeration Pipe Grate to top end of the sleeved Aeration Pipe Tube extending above grade. Provide appropriate Pipe Grate indicated for the application.
- F. Quantity Schedule:
 - 1. Provide one (1) Tree Root Aeration Unit assembly for each tree up to but not including a 24"-box container size.
 - 2. Provide two (2) Tree Root Aeration Unit assemblies located at opposing sides of the root ball and at opposite ends of the Tree Stakes and/or Deep Watering Bubblers, for each tree sized at 24"-box container and up to but not including a 48"-box container size.
 - 3. Provide three (3) Tree Root Aeration Unit assemblies, located equidistant along the sides of the root ball, for each tree sized at 48"-box container and larger.
 - 4. Location: Coordinate location of Tree Root Aeration Units to be set equally and in between locations designated to receive deep watering irrigation bubblers, where applicable.

4. INSTALLATION OF ROOT CONTROL BARRIERS

- A. Plastic Root Control Barrier Panels:
 - 1. Verify the location of underground utilities prior to placement of Root Control Barrier Panels.
 - 2. Excavate sub grade to the required depth of the Panel, and install Panels as an interconnected, linear system, with the ribs of the Panels vertically aligned and facing towards the Plant Material's root mass.
 - a. Install Root Control Barrier Panels along the entire perimeter edge for trees located in raised planters (as required).
 - b. Install Root Control Barrier Panels along the entire perimeter edge of the planting area for trees located in parking lots (as required).
 - c. Install Root Control Barrier Panels for trees where the tree trunk is located within a minimum of five-feet (5') of paved surfaces (sidewalks, curbs, plazas, etc).
 - 1) Root Control Barrier Panels shall extend a minimum of ten-feet (10') from either side of the tree trunk, and follow along the profile of the paved surface being protected. Install Panels at a maximum of four-inches (4") to six-inches (6") from the edge of the paved surface.
 - d. Install Root Control Barrier Panels in specific locations as indicated on the Contract Drawings.
 - 3. Install Root Control Barrier Panels plumb, or if conditions allow, with the top of the Panel slightly inclined towards the root mass. DO NOT install with the top inclined away from the root mass.
 - a. DO NOT install Root Control Barrier Panels in a circular pattern that encloses the root mass, thus restricting future growth of the Plant Material's root system.
 - 4. Set top of the Root Control Barrier Panels at the finish graded surface, just below the mulch layer. Install per the requirements of the Manufacturer.
- B. Chemical Fabric Root Control Barrier:

1. Verify the location of underground utilities prior to placement of Chemical Fabric Root Control Barrier.
2. Follow all EPA label instructions located on the box and packaging sleeve.
3. Protect Chemical Fabric Root Control Barrier from sunlight, moisture, or excessive temperatures.
4. Excavate/trench the sub grade to the required depth of the Fabric. Install the Fabric as a linear system, set with the chemical-filled nodules extending from the face of the Fabric facing towards the root mass of the plant material. Set the top of the Chemical Fabric Root Control Barrier at the finish graded surface, just below the mulch layer. Anchor in position with pins provided by Manufacturer.
 - a. Install Chemical Fabric Root Control Barrier in specific locations as indicated on the Contract Drawings.
 - 1) Install Chemical Fabric Root Control Barrier along the entire perimeter edge of the planting area for trees located in parking lots, as required.
 - 2) Install Chemical Fabric Root Control Barrier for trees where the tree trunk is located within a minimum of five-feet (5') of paved surfaces (sidewalks, curbs, plazas, etc).
 - 3) Chemical Fabric Root Control Barriers shall extend a minimum of ten-feet (10') from either side of the tree trunk, and follow along the profile of the paved surface being protected. Install Fabric at a maximum of four-inches (4") to six-inches (6") from the edge of the paved surface.
5. Install Chemical Fabric Root Control Barrier plumb, or if conditions allow, with the top of the Fabric slightly inclined towards the root mass. DO NOT install with the top inclined away from the root mass.
 - a. DO NOT install Chemical Fabric Root Control Barrier in a circular pattern that encloses the root mass, thus restricting future growth of the Plant Material's root system.
6. In areas where Chemical Fabric Root Control Barrier is needed to be spiced or seamed, provide an eighteen-inch (18") minimum overlap between the sheets of Fabric, with no gap between the Fabric.
7. Following installation, backfill and tamp firmly to eliminate soil settling.

5. STAKING AND GUYING

- A. General: Tree Staking and Tree Guying shall be per the direction of the Landscape Architect. Staking and/or guying of trees shall be completed immediately following tree planting operations.
 1. Contactor shall provide new Tree Stake or Tree Guy assemblies; reconditioned or previously-used Tree Stake or Tree Guy assemblies shall not be permitted. Provide one (1) set of Tree Staking materials or Tree Guying materials per tree, as required. Trees shall remain plumb and straight from installation through the Contractor Warranty period. Staking and Guying assemblies shall remain the property of the Owner.
- B. Staking/Guying Methodology: Unless otherwise directed on the Contract Drawings or as directed by the Landscape Architect based on field conditions, provide the following Staking/Guying Assemblies, as measured by the size of the tree being supported:
 1. 5-gallon size Container Stock to 36"-Box Tree, or for trees up to 3" caliper: Provide Staking Method. Number of stakes per tree shall be as directed herein this Section.
 2. For trees larger than 36"-Box size or over 3" caliper: Provide Staking or Guying Method, or as directed by the Landscape Architect.
 3. Multi-trunk Trees: Provide Tree Guying Method, or as directed by the Landscape Architect.

4. Specimen-size Trees: Provide Tree Guying Method, or as directed by the Landscape Architect.
- C. Tree Staking Method:
1. Single Tree Stake (Wooden or Metal):
 - a. Locate Stake at the closest point to the main trunk as possible, yet outside of the root ball and tree branch canopy.
 - b. Firmly drive the tapered end of the Stake plumb into the undisturbed native sub-grade, perpendicular to the side of the prevailing wind, at the minimum depth indicated in the Contract Drawings, or deeper, as required, to firmly support the Stake and minimize any movement of the Stake. Do not damage the tree trunk nor branch canopy, nor penetrate the root ball with the Stake. Do not damage or splinter the Stake. Stake shall not touch the trunk nor branch canopy of the tree.
 2. Double Tree Stakes (Wooden or Metal):
 - a. Locate Stakes at the closest point to the main trunk as possible, yet outside of the root ball and tree branch canopy.
 - b. Firmly drive the tapered end of one (1) of the Stakes plumb into the undisturbed native sub-grade, perpendicular to the side of the prevailing wind, at the minimum depth indicated in the Contract Drawings, or deeper, as required, to firmly support the Stake and minimize any movement of the Stake. Do not damage the tree trunk or branch canopy, nor penetrate the root ball with the Stake. Do not damage or splinter the Stake.
 - c. Install the other Stake in similar fashion, directly opposite from the first Stake (180 degrees), and equidistant from the tree trunk.
 - d. Installed Stakes shall not touch the trunk nor branch canopy of the tree.
 3. Tying to Tree Stakes (Wooden or Metal):
 - a. Tree Straps: Wrap and twist the Tree Strap around the tree trunk, at the lowest point where the tree gains the highest support, per the direction of the Landscape Architect. Secure the Strap with wire; thread the wire through the grommet ends of the Strap and twist wire to secure. Wrap other end of wire around the Stake, twist, and secure it to the Stake. (For Metal Stakes, thread wire through holes drilled through the stake). Repeat for other Stake(s), as required. For trees requiring multiple tree straps, locate additional straps as required along the tree trunk to provide additional vertical support. Cut off and bend back excessive wire beyond the twists to the Stake(s) to provide a safe condition. The tree shall be supported accordingly to assure a straight, firm position of the tree canopy, yet to allow enough slack to avoid rigid restraint of the tree.
 - b. Once the tree is thoroughly staked, carefully remove the nursery stake(s). Backfill and tamp the nursery stake void(s) with planting soil.
- D. Metal T-Bar Type Tree Staking Method:
1. Tree should be oriented with the nursery stake tied on the same side as the tree stake.
 2. Locate the tree stake 12-14 inches away from the trunk of the tree, and locate it on the prevailing wind side of the tree. The tree trunk should be one- to three-inches (1"-3") from the end of the T-bar.
 3. Using the manufacturer-supplied anti-rotation pin, twist/auger the tree stake firmly into the ground until the stake tab is one- to two-inches (1"-2") below grade. Drive the anti-rotation pin taught the hole in the tab and into the soil. The soil shall be firmly packed around the stake. The stake shall be set plumb.
 4. Once the tree stake is set, carefully remove the nursery stake. Backfill and tamp the nursery stake void with planting soil.
 5. Determine the correct height for the T-bar on the tree stake. It should be no higher than necessary but high enough to hold the tree upright. To locate the correct point to mount the T-bar, hold the trunk of the tree in one hand and gently bend the top with the other.

- Find the lowest height at which the top returns upright, and mark the tree stake six- to eight-inches (6"-8") higher than that point. Slip the T-bar over the top of the tree stake to the marked height, and tighten the set bolt.
6. Place the UV-resistant tubing strap around the tree trunk, and slip the ends of the tubing over the ends of the T-bar. Fold both sides of the tubing towards the tree trunk and against the T-bar, and secure the tubing with the provided cable ties in a criss-cross fashion. Trim the excess ends of the cable ties.
- E. Tree Guying: Install guying assembly per the Manufacturer's latest printed instructions.
- F. Sub-Surface Suspender Guying for On-Structure Applications:
1. Concrete slab shall be placed and cured with reinforcement bars tie rods prior to placement of tree.
 2. Reinforcement Tie Rods shall be placed as indicated on the Contract Drawings.
 3. Attach suspender strap reinforcing as indicated on the Contract Drawings. Attach straps to the reinforcement tie rods. Cinch and secure straps with the suspender strap tensioners over the rootball cover with wooden strapping frame. Suspending straps shall not come in contact with the rootball.
 4. Suspender Strap Tensioners shall be secured and are to hold strap taught over the rootball and strapping frame of the tree's rootball.
 5. Strapping Frame shall be installed as indicated on the Contract Drawings, and shall act as a protection buffer between the straps and the rootball.
6. INSTALLATION OF EROSION CONTROL MATERIALS
- A. Clear away trash, large stones, and other debris. Prepare sub grade; fine grade area to receive Erosion Control Material, eliminating footprints, tracks, and ruts.
 - B. Sequences: For hydroseed applications, install the seed slurry prior to installing the Erosion Control Material. In applications where rooted stock is planted on the slope, care shall be exercised to prevent disruption or damage to the underlying material. <VERIFY>
 - C. Unroll Material as close as possible to its intended final position to minimize the need to drag the Material which would dislocate underlying materials or disturb the prepared sub grade or planting. Install Material flush and completely in contact with the ground. Confirm that there is no tension on the Material to minimize soil contact.
 - D. Overlap Material at a minimum of four-inches (4") on the sides and eighteen-inches (18") on the ends. Staples shall be inserted at intervals no greater than three-feet (3') on-center along overlaps and down the center of each roll length.
 - E. Joining rolls of the Material shall be installed at the down-channel end of the installed roll, which should overlap the up-channel end of the roll being installed. Overlap should be a minimum of eighteen-inches (18"). Equally set staples on twelve-inch (12") on-center spacing.
 - F. Anchor slot at top of slope shall be installed by burying up-channel end in a six-inch (6") minimum deep trench. Equally set staples on twelve-inch (12") on-center spacing.
 - G. On slopes less than six-feet (6') in height, Material may be installed with roll perpendicular to the contours.

- H. The terminal fold shall be installed by bringing the Material down to the level area before terminating. Turn the end under a minimum of six-inches (6"). Equally set staples across the fold at twelve-inch (12") on-center spacing.

7. INSTALLATION OF LANDSCAPE EDGINGS (HEADERS/EDGINGS/MOWSTRIPS)

- A. General: Install in location(s) in solid undisturbed soil, or in soil set at ninety-percent (90%) relative compaction, at areas as indicated on the Contract Drawings.
 - 1. Horizontal Alignments:
 - a. Straight Alignments: Where indicated on the Contract Drawings, install Landscape Edgings in straight/angular sections, true to the alignments as indicated, free of "wiggles" or bends, using strings as guides.
 - b. Curved Alignments: Where indicated on the Contract Drawings, install Landscape Edgings in curved/radial sections, true to the alignments as indicated, free of "wiggles" or bends, following marked alignments as reviewed in the field by the Landscape Architect.
 - 2. Vertical Alignments: Install parallel to and following along the contoured finished grade.
 - 3. Refer to Section 321323 – Site Concrete, for Edging/Header installation requirements constructed with concrete-based materials.
 - 4. Refer to the Manufacturer's latest printed instructions and Contract Drawings for requirements of Landscape Edgings/Headers fabricated from metal materials.

8. MULCHING

- A. General: Mulch backfilled surfaces of pits, trenches, planted areas, and other areas indicated.
- B. Shredded Wood Mulch:
 - 1. General: Verify locations to receive Shredded Wood Mulch.
 - 2. Apply the following average thickness of Shredded Wood Mulch, and finish level with adjacent finished surfaces. Do not place Shredded Wood Mulch directly against trunks or stems of Plant Materials. Remove Shredded Wood Mulch that is placed against the growing bases or within the basal nodes of plants.
 - 3. Thickness/Depth: Three-inches (3"), minimum.
 - 4. While settlement and/or decomposition of the Shredded Wood may occur during the duration of the Contract, the Shredded Wood Mulch thickness as indicated shall be consistent throughout the duration of the Contract. The Contractor shall provide additional Shredded Wood Mulch, as needed, and as directed by the Landscape Architect, to maintain the specified constant thickness of the Shredded Wood Mulch, until Acceptance of Work is granted.
- C. Aggregate Surfacing: :
 - 1. Refer to Section 321500 – Aggregate Surfacing for installation requirements.

9. INSTALLATION OF MISCELLANEOUS MATERIALS

- A. Anti-Dessicant: Apply using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
 - 1. When deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving and again two (2) weeks after planting.

- B. Stress Reducing Agent: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions.
- C. Wetting Agent & Soil Penetrant: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions.
- D. Herbicides: Apply, as required and directed by the Landscape Architect, per Manufacturer's latest printed instructions.
- E. Plant Vitamin/Root Stimulant: Apply, per the Manufacturer's latest printed instructions. Refer to application requirements per Section 329300 – Exterior Plants.

10. CLEAN UP AND PROTECTION

- A. For Work under this Section, keep Work area in a clean, orderly, and safe condition. Contractor shall remove trash caused from his Work on a weekly basis throughout the duration of the Work.
- B. Protect landscaping from damage due to landscape operations, operations by other Contractors and trades, and trespassers. Maintain protection during installation and landscape establishment periods. Treat, repair, or replace damaged Landscape Planting Accessories as directed.
- C. Upon completion of his Work under this Section, the Contractor shall remove rubbish, waste, debris, excess construction materials, and other items resulting from construction operations offsite as described herein this Section and directed by the Landscape Architect.

11. FINAL REVIEW

- A. Final Review under this Section shall be performed upon completion of the Landscape Establishment Period. (Refer to Section 329813 – Landscape Establishment Period for requirements).

END OF SECTION

SECTION 329813 – LANDSCAPE ESTABLISHMENT PERIOD

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work, as required to make a complete Landscape Establishment Period (“Service”), as specified during progress of the Work, after installation, for a designated period after Preliminary Acceptance, as shown in the Contract Drawings, and as specified herein this Section.
- B. Contractor acknowledges that the Services specified under this Section are not intended to express every detail of the Services to be provided by Contractor, and Contractor hereby represents that it is experienced and competent in providing Services that meets or exceeds generally accepted practices commensurate with those provided by other companies that provide such Service.
- C. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Establishment of Landscape Installation, for a given frequency and duration as specified herein this Section. Work includes the following:
 - a. Litter Control.
 - b. Weed Control.
 - c. Pest Control.
 - d. Plant Care.
 - e. Fertilization of Plant Materials.
 - f. Plant Replacement.
 - g. Plant Pruning.
 - h. Plant Staking and Adjustments.
 - i. Temporary Plant Protection.
 - j. Operation, Adjustment, and Maintenance of Irrigation Controller and Irrigation System.
 - k. Cleaning of Paving Surfaces.
 - l. Reapplication of Mulching Materials.
 - m. Raking of Decomposed Granite, Aggregate Surfacing, etc.
 - n. Erosion Control and Drainage.
 - o. Removal of Green Waste.
- D. Related Sections: The following Sections contain requirements that relate to Work in this Section:
 - 1. Section 312219 – Landscape Grading.
 - 2. Section 321513 – Site Paving & Landscape Mulch.
 - 3. Section 328400 – Irrigation Systems.
 - 4. Section 329113 – Soil Preparation.
 - 5. Section 329200 – Lawns & Grasses.
 - 6. Section 329300 – Exterior Plants.
 - 7. Section 329400 – Landscape Planting Accessories.

2. DEFINITIONS AND APPLICABLE STANDARDS

A. References:

1. USDA – United States Department of Agriculture.
2. ASTM – American Society for Testing & Materials.
3. ANSI – American National Standards Institute.
4. ISA – International Society of Arboriculture.

B. Standards:

1. American National Standard for Tree Care Operation, Tree, Shrub, and Other Woody Plant Maintenance (ANSI A300), American National Standards Institute, Latest Edition.
2. American National Standard for Tree Care Operations (ANSI Z133), American National Standards Institute, Latest Edition.
3. Tree Pruning Guidelines, International Society of Arboriculture, 1995 Edition.
4. Pruning Standards for Shade Trees, National Arborists Association, Latest Edition.

3. SUBMITTALS

A. General:

1. Collect information into a single Submittal for each element of construction and type of product or equipment identified under this Section for review.
2. To expedite review, Submittal shall be organized and presented into specific sections or headings. Furnish neat, concise, legible, and clearly identifiable information, and sufficiently explicit detail, to enable proper evaluation for Contract compliance. Highlight catalog, product data, or brochures containing various products, sizes, and materials to show particular item submitted.
3. Submittal Format: As applicable, furnish Submittal as a single electronic digital PDF (Portable Document Format) file.

B. Digital Submittal Information:

1. Quality Control Submittal:
 - a. Qualification Data: Submit names for firms and persons specified in the “Quality Assurance and Control” Article to demonstrate their capabilities and experience on similar Landscape Planting Accessories installations.
 - b. Schedule of maintenance operations and monthly status report, including list of equipment, materials proposed for the job, and watering schedule(s).
 - c. Licenses, permits and insurance required by the local jurisdiction, the State, or Federal government, pertaining to Work under this Section.
 - 1) Pesticide Applicator: Valid **California** Qualified Applicator Certificate (QAC), with “B – Landscape Maintenance” Category, as administered by the California Department of Pesticide Regulation (DPR).
 - 2) Employer of the **California** Qualified Applicator Certificate (QAC), with “B – Landscape Maintenance” Category:
 - a) The company which employs the person holding the QAC must possess a Maintenance Gardener Pest Control Business License, as administered by the California Department of Pesticide Regulation (DPR).
 - d. Monthly record of herbicides, insecticides and disease control chemicals used for the Project.
 - e. Written application recommendation by a licensed agricultural pest control advisor for weed, pest and disease controls restricted by the Director of Agriculture proposed for this Work.
2. Project Closeout Submittal:
 - a. Include in a single 3-ring binder a Landscape Maintenance Manual for use by the Owner, containing an indexed collection of all schedules, records and permits

listed above, including documentation of accepted condition of planting and irrigation at Final Acceptance.

- C. Material Samples: Not required.
- D. Scaled Shop Drawings: Not required.
- E. Field-Constructed Mock-ups: Not required.
- F. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested. Partial Submittals will not be accepted.
- G. No Work shall proceed under this Section until Submittal requirements indicated herein have been reviewed accordingly by the Landscape Architect.

4. QUALITY ASSURANCE AND CONTROL

- A. Qualifications:
 - 1. Valid **California** C-27 (Landscaping Contractor) License.
 - 2. Experience: Contractor or sub-contractor performing Work under this Section shall have a full-time employee assigned to the Project as foreman for the duration of the Contract. Employee shall have a minimum of four (4) years experience in landscape maintenance supervision, with experience or training in entomology, pest control, soils, fertilizers and plant identification. Employee shall speak English fluently.
 - 3. Labor Force: Landscape maintenance labor force shall be thoroughly familiar with, and trained in, the Work to be accomplished, and shall perform the task in a competent, efficient manner acceptable to the Owner.
- B. Requirements:
 - 1. Supervision: Landscape Maintenance Foreman shall directly supervise the Work force during duration indicated herein this Section. Notify Owner of changes in supervision.
 - 2. Identification: Provide proper identification during duration for landscape maintenance firm's vehicles and labor force. Be uniformly dressed in a manner satisfactory to the Owner.

5. PROJECT/SITE CONDITIONS

- A. Site Visit: At beginning of the designated Landscape Establishment Period, visit and tour the site with the Owner's Representative, Landscape Architect, and other interested parties, to clarify the scope of Work, and understand existing project/site conditions.
- B. Documentation of Conditions: Document the general condition of installed plant materials, recording those which are healthy and thriving, and unacceptable materials which are damaged, dead, and/or dying and in need of replacement.
- C. Irrigation System: Document general condition of existing irrigation system, making sure that faulty, improper, and/or non-functioning irrigation materials or equipment are reported.

6. SEQUENCING AND SCHEDULING

- A. Perform Work under Landscape Establishment Period during hours mutually agreed upon between Owner and Contractor.
- B. Work force shall be present at the Project Site at a minimum duration indicated in this Section, and at other times as necessary, to perform specified Work, in accordance with the approved schedule under the Landscape Establishment Period.

7. WARRANTY

- A. Specific Requirements: Refer to the following Sections:
 - 1. Section 328400 – Irrigation Systems.
 - 2. Section 329200 – Lawns & Grasses.
 - 3. Section 329300 – Exterior Plants.
 - 4. Section 329400 – Landscape Planting Accessories.

2.PRODUCTS

1. MATERIALS

- A. General: Materials and equipment as required to perform Work under this Section shall be provided by Contractor.
- B. Water: Clean, potable and fresh, as available from Owner.
- C. Fertilizers:
 - 1. Fertilizer Tablets: Tightly compressed, slow-release and long-lasting complete fertilizer tablets, bearing manufacturer's label of guaranteed analysis of chemicals present. Refer to Section 329113 – Soil Preparation, for requirements.
 - 2. Balanced, once-a-season application, controlled-release Fertilizer(s), with a blend of coated prills which supply controlled-release nitrogen, phosphorus and potassium, and uncoated, rapidly soluble prills containing nitrogen and phosphorus.
- D. Herbicides, Insecticides, and Fungicides:
 - 1. Provide materials with original manufacturers' containers, properly labeled with guaranteed analysis.
 - 2. Use non-staining materials.
- E. Replacement Tree Guys, Stakes, Ties and Wires: Match originally accepted existing materials installed on the Project.

2. EQUIPMENT

- A. General: Use only the proper tool(s) required for each task under this Section.
 - 1. Maintain tools in sharp, properly-functioning condition.
 - 2. Clean and sterilize all pruning tools prior to usage.
- B. Insect/Disease Prevention: Provide measures to prevent introduction of insect or disease-laden materials onto the Site. Refer to Section 329300 – Exterior Plants.

3.EXECUTION

1. FREQUENCY AND DURATION OF LANDSCAPE ESTABLISHMENT PERIOD

- A. Following satisfactory completion of all items included on the Landscape Punch List, the contracted Landscape Establishment Period shall commence and progress.
- B. Frequency and Duration:
 - 1. Work performed under this Section shall be executed by Contractor at a minimum of once per week, for a duration of a minimum of 90 calendar days.

2. COMMENCING THE LANDSCAPE ESTABLISHMENT PERIOD

- A. Preliminary Review: As soon as landscape installation is substantially completed per the Contract Documents, Contractor shall arrange to hold a preliminary review on-site with the Landscape Architect, Owner, and other interested parties to evaluate the condition and execution of the completed Work. Evaluation of the Work shall be executed by the Landscape Architect through a "Landscape Punch List".
- B. Date of Review: Notify Landscape Architect at least five (5) working days prior to anticipated Date of Review.
- C. Commencing the Landscape Establishment Period: The date on which the Landscape Architect determines that the landscape installation is substantially-complete, whereas outstanding Work included on the Landscape Punch List is addressed and satisfactorily completed to the satisfaction of the Landscape Architect.

3. PREPARATION

- A. Protection:
 - 1. Protect new landscape planting areas from damage during duration of Landscape Establishment Period, until Final Acceptance.
 - 2. Provide temporary protection fences, barriers and signs, as required, for protection.
- B. Replacements:
 - 1. Immediately treat or replace plant materials as directed, which become damaged or injured as a result of Contractor's operations or negligence, per the Landscape Architect, at no additional cost to Owner.
 - 2. Replacement plant materials shall match size and variety of plant material being replaced.

4. PLANTING ESTABLISHMENT

- A. Watering Basins:
 - 1. Maintain watering basins around the perimeter of the installed plant materials so that enough water can be applied to establish and maintain adequate soil moisture through the root zone of the plant materials. Re-dish and tamp basins accordingly which have become damaged or have failed since installation.
 - 2. For supplemental hand watering of watering basins, use a water wand to break the water force. Do not permit use of "jet" type watering equipment. Do not permit crown roots to become exposed to air through dislodging of soil and mulch.

3. Mulch: Maintain originally specified thickness of mulch material to reduce evaporation and frequency of watering.
 4. During rainy season, open basins to allow surface drainage away from the root crown where excess water may accumulate. Restore watering basins at end of rainy season.
 5. At the end of the rainy season, re-dish and tamp watering basin at trees and shrubs.
- B. Settlement of Plant Materials: Reset/replant sunken or settled plant materials to proper grades and in upright position.
- C. Weed Control:
1. Planting areas throughout site shall be weed-free at all times, including areas between plants and along watering basins.
 2. Use only recommended and legally-approved herbicides to control and maintain weed growth.
 3. Avoid frequent soil cultivation that destroys shallow roots and breaks the seal of pre-emergent herbicides.
- D. Pruning:
1. Prune trees to select and develop permanent scaffold branches that are smaller in diameter than the trunk or branch to which they are attached, and which have vertical spacing of eighteen-inches (18") to forty-eight-inches (48") and radial orientation so as not to overlay each another.
 2. Prune trees to eliminate diseased or damaged growth, and narrow "V-shaped" branch forks that lack strength. Reduce toppling and wind damage by thinning-out crowns.
 3. Prune trees to maintain growth within space limitations, maintaining a natural appearance and balancing crown with roots.
 4. No stripping of lower branches of young trees shall be permitted.
 5. Retain lower branches in a "tipped back" or pinched condition to promote caliper trunk growth. Do not cut back to fewer than six (6) buds or leaves on such branches. Only cut lower branches flush with the trunk after the tree is able to stand erect without staking or other support.
 6. Thin out and shape evergreen trees when necessary to prevent wind and storm damage. Do primary pruning of deciduous trees during the dormant season. Do not permit any pruning of trees prone to excessive "bleeding" during growth season.
 7. Prune damaged trees or those that constitute health or safety hazards at any time of year as required.
 8. Make pruning cuts clean and close to the trunk, without cutting into the branch collar. "Stubbing" will not be permitted. Cut smaller branches flush with trunk or lateral branch. Make larger cuts one-inch (1") diameter or larger parallel to shoulder rings, with the top edge of the cut at the trunk or lateral branch.
 9. Branches too heavy to handle shall be pre-cut in three (3) stages to prevent splitting or peeling of bark. Make the first two (2) cuts eighteen inches (18") or more from the trunk to remove the branch. Make the third cut at the trunk to remove the resulting stub.
 10. Do not prune or clip shrubs into balled or boxed forms unless specifically called for by design.
 11. Clip shrubs to be hedged when branches project two-inches (2") beyond limit of clipped hedge shown on the Contract Drawings.
 12. Take extreme care to avoid transmitting disease from one infected plant to another. Properly sterilize pruning tools before going from one infected plant to other plant materials.
- E. Staking and Guying of Trees:

1. Adjustments: Inspect stakes and guys periodically (minimum once per month) throughout duration of Landscape Establishment Period to check for rubbing of staking materials on trunks or branches causing bark wounds.
2. Repair and replace faulty staking and guying materials as shown and as specified.

F. Maintenance of Existing Plant Materials to Remain:

1. General: Conform to applicable paragraphs regarding pruning, watering, spraying and fertilizing of new plant materials as indicated herein this Section.
2. Symptoms: Be alert to symptoms of construction damage to existing plantings as evidenced by wilting, un-seasonal or early flowering or loss of leaves, and insect or disease infestation due to declining vigor.
3. Notification: Submit in writing of evidences of declining vigor immediately upon discerning the problem. Take appropriate interim measures to mitigate the severity of the problem as specified in this Section.
4. Proposal: Submit written proposal and cost estimate for the correction of all conditions before proceeding with permanent correction Work.

5. GROUNDCOVER ESTABLISHMENT

A. Irrigation:

1. Check for moisture penetration throughout the root zone at least twice a month.
2. Water as frequently as necessary to maintain healthy growth of groundcovers.

B. Weed Control:

1. Control weeds, preferably by hand removal, with pre-emergent herbicides and with selective systemic herbicides.
2. Minimize hoeing of weeds in order to avoid plant damage.

C. Fertilization:

1. Recently installed plant materials: Verify with Owner actual completion date of planting installation and rate of prior application of fertilizers.
2. New Plant Materials: Place Planting Tablets (per Section 329113 – Soil Preparation) beside the root ball about one-inch (1”) from root tips.
3. Established Plant Materials: Do not use complete fertilizers unless soil test shows specific nutrient deficiencies.

D. Mowing and Edging:

1. Edge groundcovers to keep in bounds. Trim top growth as necessary to achieve an overall even appearance.
2. Ground covers which lend themselves to mowing shall be mowed to specified height above finished grade in order to renew growth, improve density and attractiveness.

E. Replacements:

1. Replace dead and missing plants after obtaining Owner's agreement to pay for replacement.
2. Damages due to Contractor's negligence shall be paid for without charge to Owner.

6. TURF GRASS ESTABLISHMENT

A. Irrigation:

1. Irrigate Turf Grass at such frequency as weather conditions require, to replenish soil moisture to six inches (6”) below root zone.

2. Provide a total of one-one-half inches (1-1/2") of water weekly, during hot summer weather, in three (3) applications per week, minimum.
3. Water at night if irrigation system is electrically controlled. Otherwise, watering shall be done during early mornings.

B. Weed Control:

1. Control broadleaf weeds with selective herbicides.
2. In areas where crabgrass has infested the turf grass, apply a selective post-emergent herbicide as soon as possible, and prior to flowering.
3. Apply pre-emergent herbicides prior to crabgrass germination.
4. Do not irrigate for forty-eight (48) hours after application of herbicidal sprays.
5. Coordinate application of herbicides with thatch control and reseeding schedule as described below.

C. Mowing and Edging:

1. Mowing:
 - a. Mow Turf Grass at a frequency so the maximum grass heights are maintained as listed below:

Turf Type	Growing Season	Dormant Season
Bluegrass or Tall Fescue	2 to 4"	2 to 3"
Perennial Ryegrass	2.5 to 3.5"	2 to 3"
Hybrid Bermuda	1.5 to 2"	2 to 3"
St. Augustine	2.5 to 4"	2 to 3"

- b. Mulching mowers shall not be used.
 - c. Turf grass shall be cut with rotary mowers to maintain a uniform and horticulturally correct height.
 - d. Blades shall be kept sufficiently sharp and properly adjusted to provide a cleanly-cut grass blade. Grass blade bruising, tearing, or shredding shall be prevented.
 - e. Mowing pattern/direction shall be rotated weekly where feasible to prevent rutting and minimize compaction.
 2. Edging:
 - a. Sidewalks, curbs, plants, walkways, roadway edges, space between planter beds, curbs, headers, and bed edges shall be mechanically edged with a steel blade edger on each visit, not to exceed seven (7) days, to maintain a neat, clean turf edge. String-type edgers shall not be used for this function.
 - b. Clippings shall either be vacuumed or blown-off all surfaces, or may be blown back to lawn, but no visible clumps of cut grass shall remain. Clippings, if bagged, shall be removed from the property on the same day the property is serviced.
 3. String Trimming:
 - a. String Trimming shall be performed on a weekly basis around roadway signs, guard posts, trees, shrubs, utility poles, and other obstacles where mowers cannot reach. Do not allow string trimming to damage the trunk or foliage of plants.
 - b. Grass shall be trimmed to the same desired height as determined by the mowing operation.
 - c. Particular shall be given to trimming around sprinkler heads and other irrigation appliances to provide maximum water coverage.

- d. Turf adjacent to tree wells, valve boxes, and quick coupling valves shall be trimmed as needed to maintain a clean appearance. Chemical defoliant or herbicides shall not be used as an “edger” in these areas.
 4. Chemical Edging:
 - a. Chemical application may be used to kill weeds and turf in and around areas adjacent to buildings, the base of fence lines, or where bed edges do not exist.
 - b. Chemicals shall be used accordingly to applicable rules and regulations.
- D. Reseeding/Overseeding:
 1. Reseeding/Overseeding: Match existing seed mix of adjacent areas. Refer to Section 329200 – Lawns & Grasses.
- E. Renovating of Existing Lawns (where applicable):
 1. Thatch Control: Maintain thatch layer at 1/2 in. depth or less. Verticut as required.
 - a. Three (3) weeks before verticutting turf grass, apply nitrate fertilizers.
 - b. Perform verticutting operations preferably in the fall months, but otherwise during the spring months. Remove all debris from verticutting. Overseed as needed.
 - c. Over-seeding must not be followed by application of pre-emergent herbicides for at least four (4) to six (6) weeks. Normally this means that turf grasses invaded by weeds shall be renovated and over-seeded in the Fall, and treated for weed control in the following late Winter.
- F. Core Aeration:
 1. Do not perform aeration work during season of active weed germination.
 2. Aerify compacted areas to improve water penetration when needed, using a piston-driven aerifier with hollow tines. Rake up and remove all resulting soil cores. Fertilize and irrigate immediately after clean-up of cores.
 3. Contractor shall be responsible for locating and flagging irrigation devices, equipment, and lines prior to aerating.
- G. Fertilization:
 1. Recently seeded/sodded Turf Grass areas: Verify with Owner previous applications of fertilizer(s).
 2. Established Turf Grass areas: Apply a slow-release (3 to 5 months) fertilizer (21-8-8; N-P-K) once in spring and again in the fall at the following rates:

<u>Program</u>	<u>1000 sq. ft.</u>	<u>Acre</u>
Optimum	15 lbs.	650 lbs.
Medium	12 lbs.	500 lbs.
Low	8 lbs.	350 lbs.

3. Apply fertilizer when turf grass is dry and preferably after mowing. Do not apply during hot weather or when turf grass is under stress. Water immediately after application.
 4. Apply only nitrogen unless a soil test shows a specific nutrient deficiency.
 5. If soil pH gets below 6.0, then a basic fertilizer such as calcium nitrate may be preferable to an acidic fertilizer. Follow the soil chemist's recommendation when deficiencies appear.
7. INSECTS, PESTS, AND DISEASE CONTROL

- A. Inspection: Inspect plant materials for signs of stress, damage and potential trouble from the following:
 - 1. Presence of insects, moles, gophers, rabbits, ground squirrels, snails and slugs in planting areas.
 - 2. Discolored or blotching leaves or needles.
 - 3. Unusually light green or yellowish green color inconsistent with normal green color of leaves.
- B. Personnel: Only licensed, qualified, trained personnel shall perform spraying for insect, pest and disease control.
- C. Application: Spray with extreme care to avoid all hazards to any person or pet in the area or adjacent areas.
- D. Lawn or vegetation-damaging pests shall be controlled in a timely manner to minimize damage.

8. IRRIGATION

- A. General:
 - 1. Apply water in sufficient quantities and as often as seasonal conditions require to keep installed planted areas moist at all times, well below the root system of plants. Hand water as required if irrigation system is not fully functional.
 - 2. Repair without additional charge to Owner damages to Irrigation System caused by Contractor's operations. Perform repairs within one (1) watering period.
 - 3. Report promptly to Owner accidental damage not resulting from Contractor's negligence or operations.
 - 4. Twice a month, use a probe or other acceptable tool to check the rootball moisture of representative plants as well as the surrounding soil.
- B. Cleaning and Monitoring the System:
 - 1. Continually monitor the irrigation systems to verify that they are functioning properly as designed. Make program adjustments required by changing field conditions.
 - 2. Prevent spraying on windows, building walls, by balancing the throttle control on the remote control valves and the adjustment screws on the sprinkler heads. Do not allow water to atomize and drift.

9. AGGREGATE SURFACING MATERIALS

- A. Aggregate Surfacing:
 - 1. Maintain Aggregate Surfacing materials at the depth indicated in the Contract Documents. Replace Aggregate Surfacing that is unlike in character (color, size, texture). Defective, fractured, stained, or material which does not meet the requirements herein in this Section shall be removed and replaced with appropriate Aggregate Surfacing material as specified.
 - 2. Rake Aggregate Surfacing surfaces smooth, consistent, and level, with no depressions, voids, rills, footprints, etc. Fines from the Aggregate Surfacing that are located on the finished surface shall be raked and/or removed accordingly to maintain a clean, consistent Aggregate Surfacing finish.
 - 3. Maintain Aggregate Surfacing free of stains, weeds, discoloration, trash, fines, debris, soil, sand, or other foreign material.
 - a. Contractor shall exercise care so as not to contaminate Aggregate Surfacing with Shredded Wood Mulches, plant materials, soil, or other foreign substances.

- b. Soil that has contaminated the Aggregate Surfacing areas shall be removed from the Aggregate Surfacing. Raking to “hide” the soil below the finished surface of the Aggregate Surfacing is not acceptable.

10. GRADING AND DRAINAGE

- A. During the Landscape Establishment Period, all flow lines shall be maintained to allow for free flow of surface water. Displaced material which interferes with drainage shall be removed and placed as directed. Low Spots and pockets shall be graded to drain properly. Jute netting or other erosion control measures as directed shall be installed at flow lines and other locations where surface erosion is evident.
- B. Damage to planting areas shall be repaired immediately and throughout the Landscape Establishment Period. Depressions caused by vehicles, bicycles, or foot traffic shall be filled and leveled. Replant damaged areas.
- C. All paved areas shall be washed and maintained in a neat and clean condition at all times.
- D. All subsurface drains and inlets shall be periodically cleared of debris, leaves, trash, etc., and flushed with clear water to avoid buildup of silt and debris.

11. CLEANING

- A. General: Dispose of pruned plant materials, vacuum turf grass clippings and leaves, sweep walkways and rake smooth mulched areas. Remove from the site containers and other evidence of maintenance activities.
- B. Litter Control:
 - 1. Site areas under the Contract shall be cleared on a weekly basis of visible litter or debris, grass clippings, and garage.
 - 2. Debris caused by normal seasonal winds shall be removed from site
 - 3. Contractor shall be responsible for disposal of debris in accordance with local rules and regulations.
- C. Blowing:
 - 1. Landscape debris generated by Work under this Section shall be blown-off or swept on a weekly basis. Do not blow grass clippings, edgings, or debris into shrub beds or onto paved areas unless after such blowing, the resultant accumulation of material is gathered and removed from the site.

12. TERMINATION OF THE LANDSCAPE ESTABLISHMENT PERIOD

- A. Final Acceptance Procedure:
 - 1. Work will be accepted by the Landscape Architect upon satisfactory completion of all Work, including Landscape Establishment Period, but exclusive of replacement of materials under the Warranty Period.
 - 2. Submit a written request to Landscape Architect for review for Final Acceptance at least five (5) working days prior to anticipated Final Review date, which is at the end of the Landscape Establishment Period.
- B. Corrective Work:

1. Work requiring corrective action or replacement shall be performed within ten (10) calendar days after the Final Review.
 2. Perform corrective Work and materials replacement in accordance with the Contract Documents, Work shall be made by the Contractor at no cost to the Owner.
 3. After corrective Work is completed, the Contractor shall again request a Final Review for Final Acceptance as outlined above.
 - a. Continue maintenance of all landscaped areas until such time as all corrective measures have been completed and accepted.
- C. Conditions for Acceptance of Work at End of Landscape Establishment Period:
1. Each plant shall be alive and thriving, showing signs of growth and no signs of stress, disease, or any other weaknesses.
 2. Replace plant materials not meeting these conditions. An additional Warranty Period equal in length to the original shall be commenced for all such plants and planted areas.
- D. Final Acceptance Date: The date on which the Landscape Architect issues a Letter of Final Acceptance. Upon Final Acceptance, Owner will assume responsibility for maintenance of the Work beyond the Landscape Establishment Period.
13. CLOSE OUT
- A. Landscape Maintenance Record:
1. Submit binder to Owner with documentation and records required and utilized during the Landscape Establishment Period.
- B. Keys and Identification: Return keys and identification materials supplied by Owner for the purpose of site access.

END OF SECTION

DIVISION 33

UTILITIES

Section 32 41 00 – Storm Utility Drainage Piping

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes drainage systems outside the building. Systems include the following:
 - 1. Storm drainage.

1.3 SYSTEM DESCRIPTION

- A. Provide systems according to the materials, workmanship, and other applicable requirements of the standard specifications of the state or of authorities having jurisdiction.
 - 1. Reference Specification: Perform all work in accordance with applicable provisions of "Standard Specifications for Public Works Construction", latest edition. Unless otherwise noted, mention herein of section numbers refers to sections of the Reference Specification. Where Reference Specification refers to "Agency", substitute the word "Owner". Where Reference Specification refers to "Engineer", substitute the word "Architect". Where Reference Specification is in conflict with these Specifications, these Specifications shall govern.
 - 2. Measurement and payment provisions and safety program submittals included in Reference Specifications do not apply to this Section.

1.4 DEFINITIONS

- A. Drainage Piping: System of pipe, fittings, and appurtenances for gravity flow of storm drainage.

1.5 PERFORMANCE REQUIREMENTS

- A. Gravity-Flow, Non-pressure Piping Pressure Ratings: At least equal to system test pressure.

1.6 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.
- B. Product data for the following:
 - 1. Pipe and fittings
 - 2. Cleanouts and drains.

- C. Inspection and test reports specified in the "Field Quality Control" Article.

1.7 QUALITY ASSURANCE

- A. Environmental Agency Compliance: Comply with regulations pertaining to storm drainage systems.
- B. Utility Compliance: Comply with regulations pertaining to storm drainage systems. Include standards of water and other utilities where appropriate.
- C. Product Options: Drawings indicate sizes, profiles, connections, and dimensional requirements of system components and are based on specific manufacturer types indicated. Other manufacturers' products with equal performance characteristics may be considered. Refer to Section "Substitution Procedures."

1.8 DELIVERY, STORAGE, AND HANDLING

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

1.9 PROJECT CONDITIONS

- A. Perform site survey, research public utility records and/or pothole as necessary to verify existing utility locations. Contact utility locating service for area where Project is located.
- B. Locate existing structures and piping to be closed and abandoned.
- C. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by the Owner or others except when permitted under the following conditions and then only after arranging to provide acceptable temporary utility services.
 - 1. Notify Architect not less than 48 hours in advance of proposed utility interruptions.
 - 2. Do not proceed with utility interruptions without receiving Architect's written permission.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate storm drainage system connections to utility company's storm drain.
- B. Coordinate storm drainage system connections to existing on-site storm drain.
- C. Coordinate with interior building drainage systems.
- D. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
1. Cleanouts and Drains:
 - a. Josam Co.
 - b. Jay R. Smith Mfg. Co. Div., Smith Industries, Inc.
 - c. Wade Div., Tyler Corp.
 - d. Zurn Specification Drainage Operation Div., Zurn Industries, Inc.,

2.2 PIPES AND FITTINGS

- A. Corrugated-Steel Pipe: ASTM A 760/A 760M, Type I, made from ASTM A 444/A 444M, zinc-coated steel sheet for banded joints.
1. Fittings: Fabricated to types indicated and according to same standards as pipe.
 2. Connecting Bands: Standard couplings made for corrugated-steel pipe to form soiltight joints.
 3. Protection: Pipe and coupling bands shall receive a bituminous coating in accordance with the Reference Specification, paragraph 207-11.5.
 4. Linings: Bituminous or concrete linings shall be applied to the interior of the pipe as specified in paragraph 207-11.5.3 of the Reference Specification.
 5. Slotted Pipe: Shall conform to paragraph 207-11.7 of the Reference Specification.
- B. Corrugated-Aluminum Pipe: ASTM B 745/B 745M, Type I, made from ASTM B 744/B 744M, aluminum-alloy sheet for banded joints.
1. Fittings: Fabricated to types indicated and according to same standards as pipe.
 2. Connecting Bands: Standard couplings made for corrugated-aluminum pipe to form soiltight joints.
 3. Flared End Sections: Shall be prefabricated galvanized steel.
- C. Polyvinyl Chloride (PVC) Sewer Pipe and Fittings: ASTM D 3034, SDR 35, with bell-and-spigot ends for gasketed joints.
1. Primer: ASTM F 656.
 2. Solvent Cement: ASTM D 2564.
 3. Gaskets: ASTM F 477, elastomeric seal.
- D. Vitrified Clay Piping for Gravity Flow: ASTM C 700 bell-and-spigot piping with ASTM C 425 compression joints.
- E. Reinforced Concrete Storm Drain Pipe and Fittings: ASTM C 76, Class as shown. Circular pipe with elliptical reinforcement shall have a readily visible line at least 12 inches long painted or otherwise applied on the inside and outside of the pipe at each end so that when the pipe is laid in the proper position, the line will be at the center of the top of the pipe. Fittings and specials shall conform to the same strength as the pipe.
1. Jointing Materials: Gaskets and pipe ends for rubber gasket joint shall conform to ASTM C 443. Gaskets shall be suitable for use with sewage.
 - a. O-Ring Gasketed bell and spigot, all concrete, with bell cast integrally with pipe, ASTM C 443.

- b. Tongue and groove, cement mortared with mortar made of one part Type II Portland Cement to two parts sand.
- F. High Density Polyethylene Pipe (HDPE) for gravity flow, smooth interior and annular exterior corrugations. Gasketed integral bell-and-spigot joint meeting the requirements of ASTM F2736. Provide pipe per Paragraph 207-18 of the Reference specification.

2.3 SPECIAL PIPE COUPLINGS AND FITTINGS

- A. Sleeve-Type Pipe Couplings: Rubber or elastomeric sleeve and band assembly fabricated to match outside diameters of pipes to be joined, for non-pressure joints.
 - 1. Sleeves for Concrete Pipe: ASTM C 443 (ASTM C 443M), rubber.
 - 2. Sleeves for Plastic Pipe: ASTM F 477, elastomeric seal.
 - 3. Sleeves for Dissimilar Pipes: Compatible with pipe materials being joined.
 - 4. Bands: Stainless steel, at least one at each pipe insert.
- B. Gasket-Type Pipe Couplings: Rubber or elastomeric compression gasket, made to match outside diameter of smaller pipe and inside diameter or hub of adjoining larger pipe, for non-pressure joints.
 - 1. Gaskets for Concrete Pipe: ASTM C 443 (ASTM C 443M), rubber.
 - 2. Gaskets for Plastic Pipe: ASTM F 477, elastomeric seal.
 - 3. Gaskets for Dissimilar Pipes: Compatible with pipe materials being joined.

2.4 CONCRETE

- A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:
 - 1. Cement: ASTM C 150, Type II.
 - 2. Fine Aggregate: ASTM C 33, sand.
 - 3. Coarse Aggregate: ASTM C 33, crushed gravel.
 - 4. Water: Potable.
- B. Structures: Portland-cement design mix, 4000 psi (27.6 MPa) minimum, with 0.45 maximum water-cement ratio.
 - 1. Reinforcement Fabric: ASTM A 185, steel, welded wire fabric, plain.
 - 2. Reinforcement Bars: ASTM A 615, Grade 60 (ASTM A 615M, Grade 400), deformed steel.

2.5 CLEANOUTS

- A. Description: Round, gray-iron housing with round, secured, scoriated, cast-iron cover as detailed on the Drawings. Include gray-iron ferrule with inside caulk or spigot connection and countersunk, tapered-thread, brass closure plug. Use units with top-loading classifications according to the following applications:
 - 1. Light Duty: In earth or grass, foot-traffic areas.
 - 2. Medium Duty: In paved, foot-traffic areas.
 - 3. Heavy Duty: In vehicle-traffic service areas.
 - 4. Extra Heavy Duty: In roads.

- B. After installation of cleanout cover and after installation of adjacent paving, if any, covers shall be sandblasted or wire brushed as necessary and painted with bituminous black paint, unless another color is required by the Architect.

2.6 DRAINS

- A. Area Drains: ASME A112.21.1M, round, gray-iron body with anchor flange and round, secured, cast-iron grate. Include bottom outlet with inside calk or spigot connection, of sizes indicated. Use units with top-loading classifications according to the following applications:
 - 1. Medium Duty: In paved, foot-traffic areas.
 - 2. Heavy Duty: In vehicle-traffic service areas.
- B. Cast-Iron Trench Drains: ASME A112.21.1M, 6-inch- (152-mm-) wide top surface, rectangular body with anchor flange or other anchoring device and rectangular, secured grate. Include units of total lengths indicated and number of bottom outlets with inside calk or spigot connections, of sizes indicated. Use units with top-loading classifications according to the following applications:
 - 1. Medium Duty: In paved, foot-traffic areas.
 - 2. Heavy Duty: In vehicle-traffic service areas.
 - 3. Extra Heavy Duty: In roads.
- C. Steel Trench Drains: Fabricated from ASTM A 242/A 242M steel plate, to form rectangular body with uniform bottom slope of 2 percent down toward outlet, anchor flange, and grate. Include units of total lengths indicated, bottom outlet of size indicated, outlet strainer, and acid-resistant enamel coating on inside and outside surfaces. Include grate openings with total free area at least 2 times the outlet cross-sectional area and with the following features:
 - 1. Plate Thickness: 1/4 inch (6.4 mm).
 - 2. Plate Thickness: 1/8 inch (3.2 mm).
 - 3. Overall Width: 7-1/2 inches (190 mm).
 - 4. Overall Width: 12-1/3 inches (313 mm).
 - 5. Grate: 3-by-3/8-inch (76-by-9.5-mm) slots.
 - 6. Grate: 3/8-inch- (9.5-mm-) diameter openings.
 - 7. Grate: 1/4-inch- (6.4-mm-) diameter openings.
 - 8. Cover: Solid with diamond pattern, where indicated.
 - 9. Weepholes in body and flashing clamping ring for units used with waterproof membrane.

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 IDENTIFICATION

- A. Materials and their installation are specified in the "Earth Moving" Section. Arrange for installation of green warning tapes directly over piping and at outside edges of underground structures.
 - 1. Use warning tapes or detectable warning tape over ferrous piping.
 - 2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 DRAINAGE PIPING APPLICATIONS

- A. General: Include watertight, silttight, or soiltight joints, except where watertight or silttight joints are indicated.
- B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to the following applications.
- C. Pipe Sizes 4 to 15 Inches (100 to 375 mm): ASTM D 3034, polyvinyl chloride (PVC) sewer pipe and fittings; solvent-cemented joints; or with gaskets and gasketed joints.
- C. Pipe Sizes 4 to 15 Inches (100 to 375 mm): ASTM D 1248, high-density polyethylene (HDPE) bell-and-spigot drainage pipe; gasketed joints.
- D. Pipe Sizes 15 to 36 Inches (375 to 900 mm): Reinforced-concrete storm drain pipe and fittings; rubber gaskets and gasketed joints; or tongue-in-groove, mortared joints.

3.4 SPECIAL PIPE COUPLING AND FITTING APPLICATIONS

- A. Special Pipe Couplings: Use where indicated and where required to join piping and no other appropriate method is specified. Do not use instead of specified joining methods.
 - 1. Use the following pipe couplings for non-pressure applications:
 - a. Straight-pattern, sleeve type to join piping, of same size, with small difference in outside diameters.
 - b. Increaser/reducer-pattern, sleeve type to join piping of different sizes.
 - c. Gasket type to join piping of different sizes where annular space between smaller piping's outside diameter and larger piping's inside diameter permits installation.
 - d. Internal-expansion type to join piping with same inside diameter.

3.5 INSTALLATION, GENERAL

- A. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of underground drainage system piping. Location and arrangement of piping layout take into account many design considerations. Install piping as indicated, to extent practical.
- B. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's recommendations for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line and pull past each joint as it is completed. Verify existing elevations prior to

extensive excavating and notify Architect of any discrepancies. Contractor shall be liable for any premature construction which must be modified due to unforeseen existing conditions.

- C. Use fittings for branch connections.
- D. Use proper size increasers, reducers, and couplings, where different sizes or materials of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- E. Install gravity-flow-systems piping at constant slope between points and elevations indicated. Install straight piping runs at constant slope, not less than that specified, where slope is not indicated.
- F. Extend drainage piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.
- G. Install drainage piping pitched down in direction of flow, at minimum slope of 1 percent (1:100) and 36-inch (1000-mm) minimum cover, except where otherwise indicated.

3.6 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. General: Join and install pipe and fittings according to the following.
- B. Polyvinyl Chloride (PVC) Plastic Pipe and Fittings: As follows:
 - 1. Join solvent-cement-joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
 - 2. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.
- C. Concrete Pipe and Fittings: Install according to ACPA "Concrete Pipe Handbook." Use the following seals:
 - 1. Round Pipe and Fittings: ASTM C 443 (ASTM C 443M), rubber gaskets or tongue-in-groove with mortar.
- D. High Density Polyethylene (HDPE) drainage pipe: Install in accordance with ASTM D2321.
- E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and fit both systems' materials and dimensions.

3.7 DRAIN INSTALLATION

- A. Install type of drains in locations indicated. Embed drains in 4-inch minimum concrete around bottom and sides.
- B. Fasten grates to drains if indicated.
- C. Set drain frames and covers with tops flush with pavement surface.

3.8 CONCRETE PLACEMENT

- A. Place cast-in-place concrete according to ACI 318, ACI 350R, and as indicated.

3.9 CLEANOUT INSTALLATION

- A. Install cleanouts and riser extension from storm drain pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in pipe.
- B. Set cleanout frames and covers in earth in a cast-in-place concrete block, 18 by 18 by 12 inches (450 by 450 by 300 mm) deep. Set with tops 1 inch (25 mm) above surrounding earth grade.
- C. Set cleanout frames and covers in concrete paving with tops flush with surface of paving.

3.10 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so finished work conforms as nearly as practical to requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch (150-mm) overlap, with not less than 6 inches (150 mm) of 3000-psi (20.7-MPa), 28-day, compressive-strength concrete.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.11 CLOSING ABANDONED DRAINAGE SYSTEMS

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either of the following procedures:
 - 1. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.
- B. Abandoned Structures: Excavate around structure as required and use the following procedure:
 - 1. Remove structure and close open ends of remaining piping.
 - 2. Backfill to grade according to the Earth Moving Section.

3.12 FIELD QUALITY CONTROL

- A. Clean interior of piping and structures of dirt and superfluous material as the work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
 2. Place plug in end of incomplete piping at end of day and whenever work stops.
 3. Flush piping between structures, if required by authorities having jurisdiction, to remove collected debris.
- B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (600 mm) of backfill is in place, and again at completion of the Project.
1. Submit separate reports for each system inspection.
 2. Defects requiring correction include the following:
 - a. Alignment: Less than full diameter of inside of pipe is visual between structures.
 - b. Deflection: Flexible piping with deflection that prevents passage of a ball or cylinder of a size not less than 92.5 percent of piping diameter.
 - c. Crushed, broken, cracked, or otherwise damaged piping.
 - d. Infiltration: Water leakage into piping.
 - e. Exfiltration: Water leakage from or around piping.
 3. Replace defective piping using new materials and repeat inspections until defects are within allowances specified.
 4. Re-inspect and repeat procedure until results are satisfactory.
- C. Test new piping systems and parts of existing systems that have been altered, extended, or repaired for leaks and defects.
1. Do not enclose, cover, or put into service before inspection and approval.
 2. Test completed piping systems according to authorities having jurisdiction.
 3. Schedule tests, and their inspections by authorities having jurisdiction, with at least 24 hours' advance notice.
 4. Submit separate reports for each test.
 5. Where authorities having jurisdiction do not have published procedures, perform tests per UNI-B-6 and the following:
 - a. Exception: Piping and soiltight joints unless required by authorities having jurisdiction.
 - b. Option: Test plastic piping according to ASTM F 1417.
 - c. Option: Test concrete piping according to ASTM C 924.
 6. Leaks and loss in test pressure constitute defects that must be repaired.
 7. Replace leaking piping using new materials and repeat testing until leakage is within allowances specified.

END OF SECTION

SECTION 334300 – LANDSCAPE DRAINAGE

1. GENERAL

1. SUMMARY

- A. This Section includes materials, labor, apparatus, tools, equipment, temporary construction, transportation, and services necessary for and incidental to performing the proper completion of Work as required to make a complete Landscape Drainage installation, as shown on the Contract Drawings, and as specified herein this Section.
- B. Work under this Section consists of, but is not necessarily limited to, furnishing and installing the following:
 - 1. Area Drain – Landscape Areas, including housing, grate, and fittings.
 - 2. Piping Materials and Fittings.
 - 3. Pre-Engineered Trench Drain (4" wide internal opening) including housing, grate, cleanouts, and accessories/fittings.
 - 4. Geotextile Filter Fabric.
 - 5. Miscellaneous Materials.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Section 312219 – Landscape Grading.
 - 2. Section 321323 – Site Concrete.
 - 3. Section 329113 – Soil Preparation.
 - 4. Section 329400 – Landscape Planting Accessories.

2. DEFINITIONS AND APPLICABLE STANDARDS

- A. References:
 - 1. ASTM – American Society for Testing and Materials.
 - 2. ANSI – American National Standards Institute.
 - 3. **CBC – California Building Code.**
- B. Material Specification Standards:
 - 1. ASTM C33 – Standard Specification for Concrete Aggregates.
- C. Material Testing Standards:
 - 1. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
 - 2. ASTM D698 – Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort.
 - 3. ASTM D1557 – Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort.
- D. Definitions:
 - 1. ABS – Acrylonitrile-Butadiene-Styrene plastic.
 - 2. HDPE – High-Density Polyethylene Plastic.
 - 3. PE – PolyEthylene plastic.
 - 4. PP – PolyPropylene plastic.
 - 5. PS – PolyStyrene plastic.
 - 6. PVC – PolyVinyl Chloride plastic.
 - 7. Subdrainage – Drainage system that collects and removes subsurface or seepage water.

8. psi – Measurement, in pounds per square inch.

3. SUBMITTALS

- A. General: Submit each item in this Article in four (4) bound Submittal Booklets and provide four (4) sets of Material Samples for review by the Landscape Architect.
- B. Submittal Booklets: Each Submittal Booklet under this Section shall be tabbed into specific sections, containing clearly identified (through yellow highlighter or other specific identification methods) and legible information on the following information indicated in this Article.
- C. Product/Material Data. Submit available Product Data, manufacturing source (name, address, and telephone number), and distributor source (name, address, and telephone number) for each type of material and product indicated herein this Section.
 1. Area Drain (landscape), including housing, grate, and fittings.
 2. Piping Materials and Fittings.
 - a. Perforated Piping.
 - b. Non-Perforated (solid-wall) Piping.
 3. Geotextile Filter Fabric.
 4. Manufacturer's technical information for each material specified including installation instructions and recommendations, as applicable.
- D. Material Samples: Submit Material Sample sets of each type of finish indicated for verification. Provide Material Sample sets for each color and texture to be used, utilizing the same tools and techniques for actual project application, to demonstrate the full range of variations expected in these characteristics.
 1. Piping Material and Fittings, 12" long section, of each type:
 - a. Perforated Piping.
 - b. Non-Perforated (solid-wall) Piping.
 2. Geotextile Filter Fabric, 12" x 12" section.
- E. Scaled Shop Drawings: Submit manufacturer's Shop Drawings for each Product/Material as indicated.
- F. Field-Constructed Mock-ups: Not applicable.
- G. Qualification Data: Submit names for firms and persons specified in the "Quality Assurance and Control" Article to demonstrate their capabilities and experience on similar Landscape Drainage installations.
- H. Submittals under this Article will be rejected and returned without the benefit of review by the Landscape Architect if they are difficult to read due to insufficient scale, poor image quality, or poor drafting quality; or if all of the required information is missing or not presented in the format as requested.
- I. No Work under this Section shall proceed until all information indicated herein this Article have been reviewed, accepted, and approved by the Landscape Architect, in writing.

4. QUALITY ASSURANCE AND CONTROL

- A. Materials and Work shall be in accordance with the California Codes and Specifications and other criteria herein specified.
- B. Installer Qualifications: Engage an experienced Installer who has completed in the last two (2) years at least three (3) installations similar in material, design, and extent to that indicated for this Project, and whose work has resulted in construction with a record of successful in-service performance.
- C. Single-Source Responsibility: Obtain each type of landscape drainage unit from a single source with resources to provide products and materials of consistent quality in appearance and physical properties, without delaying the Work.

5. DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in a timely manner to ensure uninterrupted progress of the Work. Schedule material deliveries to minimize jobsite storage.
- B. Units shall be in “new” condition when ready for installation. It shall be the responsibility of the Contractor to install “factory condition” units.
- C. All containerized products shall be delivered to the site in manufacturer's original, unopened, undamaged, legibly labeled containers, with identification labels intact. All pipe to be delivered bound securely to prevent damage. Supply pallets as required to protect products.
- D. Storage: Protect materials from damage, water and rust. Store pipes on beds which are full length of pipe. Protect plastic materials from direct sunlight.
- E. Pipe: Cap openings to prevent entry of dust, debris and other foreign matter.

6. COORDINATION, SCHEDULING AND OBSERVATIONS

- A. Notify the Contractors performing Work related to installation of Work under this Section in ample time so as to allow sufficient time for them to perform their portion of Work and that progress of Work is not delayed. Verify conditions at the Project Site for Work that affects installation under this Section. Coordinate items of other trades to be furnished and set in place.
- B. Project Conditions:
 - 1. Environmental Requirements: Comply with Manufacturer's recommendations of environmental conditions affecting product installation requirements.
 - 2. Wind and Weather Criteria:
 - a. Perform installation of Landscape Drainage only when weather and soil conditions are suitable in accordance with locally accepted practices.
- C. Protection of Utilities:
 - 1. Provide temporary support and protection of underground and surface utility structures, drains, services and other improvements to remain.
 - 2. Where grade or alignment of pipe is obstructed by existing utility structures such as conduits, ducts or pipes, permanently support, relocate, remove or reconstruct the obstruction.
 - 3. Restore all damaged improvements to original condition at no additional cost to Owner.
- D. Field Measurements and Conditions:

1. Utilities: Determine location of above grade and underground utilities and perform Work in a manner which will avoid damage to utilities. Hand excavate, as required. Maintain grade stakes until removal is mutually agreed upon by parties concerned.
 2. Excavation: When conditions detrimental to installing landscape drainage Work is encountered, such as foundations or obstructions, cease installation operations and notify Landscape Architect for further direction.
 3. Grades and Levels: Establish and maintain required levels, grade elevations, and proper clearances. Review installation procedures and coordinate Work herein this Section with other Work affected.
 4. Concealed Work: Verify locations of existing stub-outs to receive area drains. Verify and locate existing pipes and structures to be coordinated with landscape drainage Work.
 5. Traffic Control: Maintain access for vehicular, bicycle, and pedestrian traffic, as required, for other construction activities during installation of Flagpoles. Access shall also be unobstructed and maintained at all times to allow for entry and exit of emergency vehicles.
 6. Protection: Protect adjacent finished surfaces prior to application. Maintain protection until completion of Work.
 7. Notification: Submit written notification of all discrepancies in the Contract Drawings or existing conditions which preclude successful installation of landscape drainage Work as specified.
 8. The outfall for any subsurface drainage pipe, drainage mat, trench drain, or slot drain used shall be coordinated with the site drainage.
 9. Where Prefabricated Drainage Composite Matting is installed in conjunction with a waterproofing product, the Matting must be compatible with the waterproofing product and installed by methods acceptable to the waterproofing product manufacturer.
- E. Construction Site Observations: Periodic site observations shall be made by the Landscape Architect during the installation of Work under this Section for compliance with requirements. Landscape Architect retains right to observe Work for defects and to reject unsatisfactory or defective Work under this Section at any time during progress of Work. The Contractor shall request, in writing, at least one (1) week in advance of the time when mandatory site observation(s) by the Landscape Architect are required.
7. SUBSTITUTIONS
- A. Consideration: Materials to be considered equal to the Materials indicated herein this Section shall be reviewed by the Landscape Architect. Materials with equal performance characteristics produced by other Manufacturer's and/or Distributors may be considered, providing deviations in dimensional size, color, composition, operation, and/or other characteristics do not change the design concept, aesthetic appearance, nor intended performance, as solely judged by the Landscape Architect. The burden of proof on product equality is on the Contractor.
 - B. Specific reference to Manufacturer's names and products specified herein are used as standards of quality. This implies no right to the Contractor to substitute other materials without prior written approval by the Landscape Architect for Work under this Section.
 - C. Materials substituted and installed by the Contractor, without prior written approval by the Landscape Architect, may be rejected. Contractor shall not be entitled to be compensated by the Owner where the Contractor has installed rejected substitutions without receiving prior written approval.
 - D. Contract Price: Substituted Materials under this Section shall not increase the Contract price.

2.PRODUCTS

1. PIPING MATERIALS

A. Drain Piping and Fittings:

1. Perforated and Non-Perforated (solid wall) Polyvinyl Chloride (PVC) Tubing:
 - a. Type: ASTM D3034, SDR 35 tubing and fittings.
 - b. Type: ASTM D1785, PVC 1120-1220, Schedule 40.
 - c. Perforations: 3/8 in. diameter, four inches (4") apart center-to-center longitudinally, in two (2) rows, 120-degrees apart.
2. Perforated and Non-Perforated (solid wall) PolyEthylene Tubing:
 - a. Type: ASTM F405 corrugated tubing and fittings, for less than ten-inches (10") in diameter, and ASTM F667 for ten-inch (10"), twelve-inch (12"), and fifteen-inch (15") diameters.
 - b. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) Advanced Drainage Systems (ADS), Inc.
 - 2) or equal, as approved by the Landscape Architect.

2. MANUFACTURED UNITS

A. Area Drain (Landscape Applications):

1. General: Area Drain (Landscape Applications) shall consist of the complete assembly, including housing, grate, and fittings necessary to connect to sub-surface piping.
 - a. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) 1). *Nyloplast*, ADS, Hilliard, OH.
 - 2) 2). or equal, as approved by the Landscape Architect.
2. Grate:
 - a. Style:
 - 1) Flat-style Grate, sized to fit Drain Basin Structure.
 - b. Material/Color:
 - 1) Molded Polyethylene/Black.
 - c. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - 1) To be provided by Manufacturer of Area Drain Housing.
 - 2) or equal, as approved by the Landscape Architect.
3. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. Advanced Drainage Systems (ADS), Inc.
 - b. or equal, as approved by the Landscape Architect.
4. Cleanouts:
5. Accessories: Provide as required to complete assembly.
 - a. End Plates.
 - b. Outlet Plates.
 - c. Strainer.
 - d. Locking Devices.
 - e. Sealant.
 - f. Sidewall Extensions.
 - g. Installation Devices.
 - h. Catch Basins.

3. GEOTEXTILE FILTER FABRIC

- A. Geotextile Filter Fabric: Permeable, lightweight, continuous, non-woven, geo-textile polypropylene filament material, UV resistant, engineered to allow water permeability and deter soil permittivity per ASTM D4491. Geotextile Filter Fabric shall be inert to biological degradation and resistant to naturally encountered chemicals, alkalis and acids. Meet AASHTO M288-96, Class 1. Fabric shall have a permeability rating ten (10) times greater than that of soil on which fabric is founded and an AOS (apparent opening size) small enough to prevent passage of fines.
1. Products & Manufacturer's: Subject to compliance with requirements, provide products by one (1) of the following:
 - a. *Amoco 4553*, Amoco Fabrics and Fibers Company.
 - b. *FX-80HS*, Carthage Mills.
 - c. *C-80NW*, Contech.
 - d. *180 EX*, Linq.
 - e. *Geotex 801*, SI Geosolutions.
 - f. *TerraTex N08*, Webtec.
 - g. *180N*, TC Mirafi.
 - h. or equal, as approved by the Landscape Architect.

4. BACKFILL MATERIALS

- A. Sand Backfill: Coarse washed granular sand material naturally produced by the disintegration of rock, free of organic material, mica, loam, clay and other deleterious substances to be thoroughly suitable for pipe bedding, meeting ASTM C33, coarse aggregate, as modified below:
1. Properties and Gradation: Conform to the grading requirements of ASTM C33 with modifications as follows:

Grading Requirements for Coarse Sand ASTM C33 Sieve Analysis	
Sieve Size	Percent (%) Passing
No. 10	95
No. 30	<5
No. 50	<1

2. Sieve accordingly per ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

- B. Aggregate Backfill: Clean, washed, angular, neutral pH, no salinity, free from deleterious or foreign matter, meeting ASTM C33, as modified below:

1. Properties and Gradation: Conform to the grading requirements of ASTM C33 with modifications as follows:

Grading Requirements for Aggregate Backfill ASTM C33 Sieve Analysis	
Sieve Size	Percent (%) Passing
2"	100

¾"	70-100
3/8"	40-100
No. 4	25-50
No. 8	15-35
No. 30	5-18
No. 50	0-10
No. 200	0-3

2. Sieve accordingly per ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

C. Soil Backfill: Clean, native soil, free from rocks and deleterious or foreign matter

5. MISCELLANEOUS MATERIALS

A. Support for Trench and Slot Drain Housings:

1. Concrete: Composed of Portland cement, coarse and fine aggregate, and water, mixed in proportions to attain a 28-day compressive strength of not less than 2,500 PSI, complying with ASTM C94.
2. Reinforcement Bars: Meet ASTM A615, Grade 60 deformed, clean and free of rust, dirt, grease or oils.
3. Tie Wire: 16-gauge plain cold-drawn steel conforming to ASTM A82, clean, and free of rust, dirt, grease or oils.

3.EXECUTION

1. EXAMINATION

A. Verification of Conditions:

1. Verify exact locations and quantity of drains relative to planting areas, paving areas, and adjacent to paving, prior to beginning of Work.
2. Identify required lines, levels, contours, and datum.
3. Immediately report discrepancies to Landscape Architect prior to installation of landscape drainage Work.
4. Verify substrate conditions to be acceptable for product installation in accordance with manufacturer's instructions. Do not proceed with drainage installation until substrate conditions are acceptable for compliance with manufacturer's warranty requirements.

B. Deviations: Make no deviations from specified line or grade without written acceptance of change by the Landscape Architect.

2. PREPARATION

A. Adjacent Surfaces Protection: Protect adjacent Work areas and finish surfaces from damage during installation operations.

- B. Surface Preparation for Prefabricated Drainage Composite Matting: <<<VERIFY>>>
 - 1. Prepare surfaces to receive Prefabricated Drainage Composite Matting. Surfaces shall be smooth, free of depressions, voids, protrusions, clean, and free from surface contaminants that may impair the performance of drainage and Manufacturer's warranty requirements.
 - 2. Clean substrate that is to receive drainage. Remove loose debris and other harmful contaminants that will affect performance of the Prefabricated Drainage Composite Matting.
 - 3. Refer to Manufacturer's printed instructions for additional applicable preparation requirements.

3. INSTALLATION

- A. Examination: Verify exact locations and quantity of all drains relative to planting areas and adjacent to paving, prior to beginning of Work. Identify required lines, levels, contours, and datum. Immediately report to Landscape Architect all discrepancies found prior to installation of drains.
 - 1. Deviations: Make no deviations from specified line or grade without written acceptance of change by Landscape Architect.
- B. Trenching and Backfilling:
 - 1. General: Conform to applicable "Earthwork" Sections and as supplemented herein. Hand trim excavations to required elevation. Do not over-excavate.
 - 2. Obstructions and Debris: Remove hardpan, rock, mud, quicksand, debris or other unsuitable bedding material. Further excavate the trench a suitable limit as directed by the Engineer. Backfill with import material approved by the Engineer that will provide adequate pipe bedding.
 - 3. Compaction of Backfill: per Geotechnical Report.
 - 4. Backfill:
 - a. Backfill the remaining trench with excavated material to 12 in. above the top of the pipe. If excavated material is unsuitable for compaction, use imported suitable material.
 - b. Do not permit sand backfill material to mix with structural backfill within the sub-drain area.
- C. General Piping Installation:
 - 1. Install as detailed in the Contract Drawings and in accordance with the manufacturer's current printed specifications.
- D. Sub-surface Drainage System (Burrito/French Drain):
 - 1. Preparation of Trench: Accurately excavate trench as shown on the Contract Drawings.
 - 2. Geotextile Filter Fabric: Place fabric in bottom of trench and extend up sides and beyond trench. Overlap twelve-inches (12") at ends of roll.
 - 3. Drain Rock and Pipe: Install bedding portion of drain rock and bed pipe in place. Wrap pipe with Filter Fabric. Do not damage or displace geotextile filter fabric on sides of trench.
 - 4. Review: Prior to installing remaining drain rock backfill, request review by Landscape Architect for progress of the Work.
 - 5. Closing: Upon acceptance, add remaining drain rock and lap over the ends of the filter fabric as shown on the Contract Drawings.
 - 6. Soil Backfill: Backfill with permeable planting soil mix to a minimum depth of six-inches (6") above filter fabric as shown on Contract Drawings.

4. FIELD QUALITY CONTROL

- A. Tests: Field density test for compaction.
- B. Manufacturer's Field Service: Installation of Trench Drains.

5. CLEANING AND PROTECTION

- A. General: Keep clean and protect sub-drainage system until commencement of Work under, Section 329113 - Soil Preparation.
- B. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with Manufacturer's instructions.
- C. Sediments: Temporarily plug all outlets to prevent construction debris and sediments from entering drainage system. Vacuum all sediments from trench drains periodically and at the completion of Work. Do not hose (water) sediments into drainage system.
- D. Sub-Drainage: Monitor sub-drainage systems and immediately identify problems with drainage. Make adjustments as necessary to maintain proper sub-drainage flow.
- E. Protection: Protect installed products finished surfaces from damage during construction.

END OF SECTION 3234300 – LANDSCAPE DRAINAGE