

BRIDGING DOCUMENTS

TECHNICAL SPECIFICATIONS

OLD TOWN NEWHALL PARKING STRUCTURE

Prepared for:
CITY OF SANTA CLARITA

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WALKER
PARKING CONSULTANTS

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SECTION 03 10 00 - FORMWORK

PART 1 – GENERAL

1.1 FORMWORK

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

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

C. Void Forms:

   1. Prepare ground surface on level plane.
   2. Protect all forms from moisture prior to concrete placement.
   3. Install all forms and accessories in accordance with manufacturer's recommendations.
   4. Protect all forms from puncture and moisture during concrete placement including accessories such as tape joints, seam pads and end caps.

D. Construction forms tight enough to minimize loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

   1. Do not use rust-stained steel form-facing material.

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

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

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

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

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

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

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

1.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be imbedded.

1. Install anchor bolts and embed plates, accurately located, to elevations required.

2. Install dovetail anchor slots, if required, in concrete structures as indicated.

1.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 12 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 75 percent of 28-day design compressive strength.
2. For post-tensioned concrete, formwork shall remain in place until post-tensioning has been completed.
3. Determine compressive strength of in-place concrete by testing representative field or laboratory-cured test specimens according to ACI 301.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

1.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

1.5 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R, class “D” for formed surfaces.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding ACI 347R, class “B” for formed surfaces.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, damp-proofing, veneer plaster, or painting.
2. Do not apply rubbed finish to smooth-formed finish.

C. Related Uniformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

1.6 REFERENCE STANDARDS

A. Current California building code.

B. American Concrete Institute.

1. ACI 117 “Standard Tolerances for Concrete Construction and Materials.
2. ACI 347 “Recommended Practice for Concrete Formwork.”

C. American Plywood Association (APA).

D. U. S. Department of Commerce, PS-1-83 U. S. Product Standard for Construction and industrial Plywood.

1.7 QUALITY ASSURANCE

A. Accomplish shoring and reshoring design, falsework, sequence, erecting and removal so that construction loads do not exceed design loads.

B. The Contractor shall be responsible for the adequacy of all work. The Contractor shall provide adequate and safe support, bracing shoring, reshoring and stabilize all concrete forms. The contractor shall comply with all requirements of the Division of Industrial Safety, State of California.

C. Contractor shall be responsible for the accuracy of all formwork so that the end result of formed surfaces produces surface finishes conforming to reference standards.

END OF SECTION 03 10 00

SECTION 03 20 00 - REINFORCING STEEL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

Drawings and general provision of Contract, including General Conditions, Special Conditions and Division 1 Specification Sections apply to this Section.

1.2 SUMMARY

This Section specifies Mild Steel Reinforcing for Poured-in-Place Concrete.

Work Related Sections include the following: List below only products and construction that the reader might expect to find in this Section but are specified elsewhere.

1. Division 3 Section “Cast in Place Concrete.”
2. Division 3 Section "Unbonded Post-Tensioned Concrete."
3. Division 4 Section “Masonry.”

1.3 SUBMITTALS

Product Data: For each type of manufactured material and product indicated.

Steel Reinforcement Shop Drawings: Details of fabrication, bending, and placement, prepared according to ACI 315, "Details and Detailing of Concrete Reinforcement." Include material, grade, bar schedules, stirrup spacing, bent bar diagrams, arrangement, and supports of concrete reinforcement. Include special reinforcement required for openings through concrete structures.

Welding Certificates: Copies of certificates for welding procedures and personnel.

Material Certificates: Signed by manufacturers certifying that each of the following items complies with requirements:

- Steel reinforcement and reinforcement accessories.

1.4 QUALITY ASSURANCE

B. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

C. ACI Publications: Comply with the following, unless more stringent provisions are indicated:
   1. Concrete Reinforcing Steel Institute (CRSI), “Manual of Standard Practice.”

1.5 DELIVERY, STORAGE, AND HANDLING

D. Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

Reinforcing Bars: ASTM A 615, Grade 60 (Grade 420) unless otherwise noted on drawings. Bars shall be deformed. Bars to be welded shall conform to ASTM A706.

Low-Alloy-Steel Reinforcing Bars: ASTM A706, deformed.

Reinforcement Resisting Earthquake: Longitudinal reinforcement in all concrete columns and beams shall comply with low alloy A706. A615, Grade 60 may be used in these members if it meets the requirements of ACI 318-05 Section 21.2.5 parts A and B.

Plain-Steel Wire: ASTM A 82, as drawn. For tie wire, comply with Fed. Spec. QQ-W-461, annealed copper bearing steel black, 16 gauge minimum.

Welded Wire Fabric: Conform to ASTM 185 and A82. Wire mesh shall be clean, free from oil and rust. Wire size and gauge as shown, 60 k.s.i. minimum yield strength.

2.2 REINFORCEMENT ACCESSORIES

Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use either non ferrous or CRSI Class 1 plastic-protected legs.
2. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

Joint Dowel Bars: Plain-steel bars, ASTM A 615/A 615M, Grade 60 (Grade 420). Cut bars true to length with ends square and free of burrs.

Zinc Repair Material: ASTM A 780, zinc-based solder, paint containing zinc dust, or sprayed zinc.

All embedded bolts and exposed plates shall be galvanized.

Welding Electrodes: Comply with AWS A5.1, low hydrogen, E90 series.

Dowel Bar Splice System: Lenton per ICCES ER-3967, or approved equal, where approved by the Structural Engineer.

2.3 FABRICATING REINFORCEMENT

Fabricate steel reinforcement to the required shapes and dimensions, with fabrication tolerances according to CRSI's "Manual of Standard Practice."

Do not start fabrication before steel has been sampled nor before shop drawings have been reviewed.

Fabricate reinforcing steel of the indicated sizes, shapes, and lengths, spacing and other dimensions as approved on Drawings. Accurately form bars to details, shapes and lengths as indicated.

In case of fabricating errors, do no straighten or re-bend reinforcement in a manner that will weaken or injure the material. Heating of reinforcement for bending will no be allowed.

PART 3 - EXECUTION

3.1 STEEL REINFORCEMENT

General: Comply with CRSI's "Manual of Standard Practice" and industry standards for detail and method of placing reinforcement, clearances and supports.

Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars. Tie all accessories. Perform all welding in accordance with AWS D1.4 using experienced certified welders materials, and practices as required by code.

Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

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

Mechanical connectors, where required shall be approved by the Structural Engineer , be ICBO approved and installed in accordance with the splice device manufacturer’s recommendations.

END OF SECTION 03 20 00

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section specifies cast-in-place concrete, including formwork, reinforcement, concrete materials, mix design, placement procedures, finishes and other miscellaneous items related to cast-in-place concrete.

B. Concrete supplier, concrete specified here requires:

1. Water/cementitious materials ratio: See General Notes on Drawings.
2. Water Reducing Admixture: See Part 2 Article “Admixtures.”
3. High strength: See General Notes on Drawings.

C. Work in other Sections related to Cast-in-Place Concrete:

1. Division 03 Section “Unbonded Post-Tensioned Concrete.”
2. Division 07 Section “Traffic Coatings.”
3. Division 07 Section “Concrete Joint Sealants.”
4. Division 07 Section “Expansion Joint Assemblies.”
5. Division 09 Section “Painting.”
6. Division 09 Section “Pavement Marking.”

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume.

1.4 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product data for proprietary materials and items, including reinforcement and forming accessories, admixtures, patching compounds, joint systems, curing compounds, and others as requested by Engineer including, but not limited to:

1. Material Certificates: Signed by Manufacturer that each of the following items complies with requirements:

    a. Cementitious materials and aggregates
    b. Form materials and form-release agents
    c. Fiber reinforcement
    d. Admixtures
    e. Curing materials
    f. Floor and slab treatments
    g. Bonding agents
    h. Repair materials

2. Submit certification that curing compounds or evaporation retarder, if used, is compatible with sealer specified in Division 07 Section “Water Repellents”, traffic topping specified in Division 07 Section “Traffic Coatings” and sealant specified in Division 07 Section “Concrete Joint Sealants.”
3. Submit certification that curing compound or evaporation retarder is compatible with pavement markings specified in Division 09 Section “Painting.”
4. Submit certification by structural engineer licensed in California for formwork, shoring and reshoring procedures, calculations, and other work described under Part 3 heading “Forms.”
5. Contractor: Submit concrete mix design to Engineer four weeks before placing concrete. Use mix design submission form at end of this Section. Any other mix design submission form will be rejected. Proportion mix designs as defined in ACI 301 Section 4 header “Proportioning,” Mix designs shall be proportioned by party other than Testing Agency responsible for testing Project concrete. Proportion mix to minimize effects of thermal and drying shrinkage. See Part 2 heading “Concrete Mixes,” header “Shrinkage” for drying shrinkage limit. Construction means and methods shall not adversely affect low volume change characteristics of mix design. Include following information for each concrete mix design:

    a. Method used to determine proposed mix design, (ACI 301 Section 4).
    b. Gradation of fine and coarse aggregates.
    c. Proportions of all ingredients including all admixtures added either at time of batching or at job site.
    d. Water/cementitious materials ratio.
    e. Slump, ASTM C143.
    f. Certification of the chloride content of admixtures.
    g. Unit weight of concrete ASTM C138.
    h. Strength at 4 and 28 days, ASTM C39. In addition, provide strength gain curve with sufficient number of data points from 6 to 96 hours to accurately estimate time when 3000 psi strengths will be achieved for post-tensioned concrete. See Section “Unbonded Post-Tensioned Concrete.”
    i. Shrinkage (length change), ASTM C157 (modified) for cast-in-place post-tensioned concrete only. See Part 2 heading “Concrete Mixes” header “Shrinkage” for modifications to ASTM C157.

6. Contractor: At pre-concrete meeting, submit procedures to protect fresh concrete from rain.

7. Testing Agency: Promptly report all field concrete test results to Engineer, Contractor and Concrete Supplier. Include following information:

    a. See Article “Quality Assurance.”
    b. Weight of concrete, ASTM C 138.
    c. Slump, ASTM C 143.
    d. Concrete temperature at placement time.
    e. Air temperature at placement time.
    f. Strength determined in accordance with ASTM C 39.
    g. Shrinkage (length change) of superstructure concrete, ASTM C 157 (modified) for post-tensioned concrete only.

8. Contractor: Submit grout temperature limitations with grout submittal.
9. Current certification of welders.

C. Shop drawings for reinforcement:

1. Prepared for fabrication, bending, and placement of concrete reinforcement. Comply with ACI SP-66, “ACI Detailing Manual,” showing bar schedules, stirrup spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
2. Because Work of this Section and Section Unbonded Post-Tensioned Concrete” are interdependent, Contractor shall have both suppliers review the other’s Shop Drawings and note any potential interference. Contractor shall then review this Section and Sections “Unbonded Post-Tensioned Concrete” Shop Drawings against each other and inform Engineer of any potential interference.

D. Shop drawings for formwork for fabrication and erection of forms for specific exposed finish concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items that affect exposed concrete visually.

E. Engineer’s review is for general architectural applications and features only. Design of formwork for structural stability and efficiency is Contractor’s responsibility. Contractor shall retain an Engineer licensed in California to design shoring and reshoring.

F. Samples of materials as requested by Engineer, including names, sources, and descriptions as follows:

1. Normal weight aggregates.
2. Fibrous reinforcement.

G. Laboratory test reports for concrete materials and mix design test.

H. Minutes of concrete pre-installation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work 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. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in California and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for formwork and shoring and reshoring installations that are similar to those indicated for this Project in material, design, and extent.

C. Manufacturer Qualification: An experienced supplier who is experienced in manufacturing ready-mixed concrete products complying with ASTM C94 requirement for production facilities and equipment. Manufacturer shall also be certified according to the National Ready Mixed Concrete Association's Certifications of Ready Mixed Concrete Production Facilities.

D. Codes and Standards: Comply with provisions of following codes, specifications, and standards, except where more stringent requirements are shown or specified:

1. ACI 301, "Specifications for Structural Concrete."
2. ACI 318, "Building Code Requirements for Structural Concrete."
3. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
4. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
5. 2010 California Building Code.

E. Materials and installed work may require retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.

F. Concrete Pre-Installation Conference: Conduct conference at Project site to comply with requirements of Division 01 Section "Project Management and Coordination" and the following paragraph.

G. At least 21 days prior to scheduled start of concrete construction, contractor shall conduct meeting to review proposed mix designs and to discuss required methods and procedures to achieve required concrete quality. Contractor shall send pre-concrete conference agenda to all attendees 5 days prior to scheduled date of conference indicating review requirements. Representatives of each entity directly concerned with cast-in-place concrete shall attend conference, including, but limited to, the following:

1. Contractor's superintendent.
2. Laboratory responsible for concrete design mixes.
3. Laboratory responsible for field quality control.
4. Ready-mix concrete producer.
5. Concrete subcontractor.
6. Primary admixture manufacturers.
7. Engineer or Owner's representative.

The minutes shall include a statement by the Concrete Contractor indicating that the proposed mix design(s) and placing techniques can produce the concrete quality required by these specifications.

H. Welders and welding procedures shall conform to requirements of AWS D1.4. Except where shown on Drawings, welding of reinforcing steel is prohibited unless accepted by Engineer in writing.

I. Submit steel producer's certificates of mill analysis, tensile tests, and bend tests for reinforcing steel. Coordinate with welders and welding procedures.

J. Special inspections and structural tests are required in accordance with CBC Sections 109 and 1704. Inspections shall be conducted by an inspection agency employed by Owner and approved by Engineer. Inspector shall provide report in approved format to Owner with copy to Engineer and Contractor. Inspection agency has authority to reject reinforcing not meeting Contract Documents. Inspections for all reinforcing steel for conformance to Contract Documents shall be completed prior to concrete pouring.

K. Submit following information on Inspection of Reinforcement unless modified in writing by Engineer.

1. Project name and location.
2. Contractor's name.
3. Inspection Agency's name, address, and phone number.
4. Date and time of inspection.
5. Inspection Agency technician's name.
6. Fabricator's name.
7. Weather data:

    a. Air Temperatures.
    b. Weather.
    c. Wind speed.

8. Inspection location within structure.
9. Reinforcement inspection data (including but not limited to):

    a. Bar size, spacing, cover, and grade.
    b. Splices, bends, anchorages, welding.
    c. Support methods and construction sequencing.

10. Diary of general progress of Work.

L. Testing Agency:

1. Independent testing laboratory employed by Owner and acceptable to Engineer.
2. Accredited by AASHTO under ASTM C1077. Testing laboratory shall submit documented proof of ability to perform required tests.
3. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

M. Testing Agency is responsible for conducting, monitoring and reporting results of all tests required under this Section. Testing Agency shall immediately report test results showing properties that do not conform to Project Specification requirements to

General Contractor's authorized on-site representative and to Owner's authorized on-site representative.

N. Submit following Field Test information for Project Concrete unless modified in writing by Engineer:

1. Project name and location.
2. Contractor's name.
3. Testing Agency's name, address, and phone number.
4. Concrete supplier.
5. Date of report.
6. Testing Agency technician's name (sampling and testing).
7. Placement location within structure.
8. Elapsed time from batching at plant to discharge from truck at site.
9. Concrete mix data (quantity and type):

    a. Cement.
    b. Fine aggregates.
    c. Coarse aggregates.
    d. Water.
    e. Water-reducing admixture and high-range water-reducing admixture.
    f. Other admixtures, including supplementary cementitious materials.

10. Weather data:

    a. Air temperatures.
    b. Weather.
    c. Wind speed.

11. Field test data:

    a. Date, time and place of test.
    b. Slump.
    c. Unit weight.
    d. Concrete temperature.

12. Compressive test data:

    a. Cylinder number.
    b. Age of concrete when tested.
    c. Date and time of cylinder test.
    d. Curing time (field and lab).
    e. Compressive strength.
    f. Type of break.

O. Provide certification that curing compound has passed requirements of ASTM C 309.

P. All concrete flatwork finishers on Project shall hold current ACI Concrete Flatwork Finisher certification. Submit certification for each concrete flatwork finisher at Concrete Pre-construction Conference and obtain Engineer's written acceptance.

Q. Provide certification that curing compound and evaporation retarder are compatible with sealer specified in Division 07 Section “Water Repellents”, traffic topping specified in Division 07 Section “Traffic Coatings” and with sealant specified in Division 07 Section “Joint Sealants.”

R. At all times during warm and hot weather, maintain adequate supply of evaporation retarder at site. Do not use it as finishing aid. See Part 3.

S. Testing Agency: Identify those of concrete supplier’s trucks which meet requirements of RMCA Quality Control Manual. Permit only those trucks to deliver concrete to Project.

1.6 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):

1. AASHTO, “Standard Specifications for Highway Bridges.”
2. AASHTO T 318, “Measurement of Water Content of Fresh Concrete Using the Microwave Oven.”

B. American Concrete Institute (ACI):

1. ACI 117, “Standard Specifications for Tolerances for Concrete Construction and Materials.”
2. ACI 214, “Recommended Practice for Evaluation of Strength Test Results of Concrete.”
3. ACI 301, “Specifications for Structural Concrete.”
4. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
5. ACI 305R, “Hot Weather Concreting.”
6. ACI 306.1, “Standard Specifications for Cold Weather Concreting.”
7. ACI 306R, “Cold Weather Concreting.”
8. ACI 308, “Standard Practice for Curing Concrete.”
9. ACI 308.1, “Standard Specifications for Curing Concrete.”
10. ACI 318, “Building Code Requirements for Structural Concrete.”
11. ACI 347, “Recommended Practice for Concrete Formwork.”
12. ACI 362.1, “Guide for the Design of Durable Parking Structures.”

C. American Iron and Steel Institute (AISI):

1. AISI, “Specification for the Design of Cold-Formed Steel Structural Members.”

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

1. ASTM A 36, “Specification for Structural Steel.”
2. ASTM A 185, “Specification for Welded Wire Steel Fabric for Concrete Reinforcement.”
3. ASTM A 497, “Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.”
4. ASTM A 615, “Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.”

5. ASTM A 706, “Specification for Low-Alloy Steel Deformed Bars for Concrete Reinforcement.”
6. ASTM C 31, “Method of Making and Curing Concrete Test Specimens in the Field.”
7. ASTM C 33, “Specification for Concrete Aggregates.”
8. ASTM C 39, “Test Method for Compressive Strength of Cylindrical Concrete Specimens.”
9. ASTM C 94, “Specification for Ready-Mixed Concrete.”
10. ASTM C 109, “Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50-mm Cube Specimens).”
11. ASTM C 138, “Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete.”
12. ASTM C 143, “Test Method for Slump of Portland Cement Concrete.”
13. ASTM C 150, “Specification for Portland Cement.”
14. ASTM C 157, “Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete.”
15. ASTM C 172, “Method of Sampling Freshly Mixed Concrete.”
16. ASTM C 309, “Specification for Liquid Membrane-Forming Compounds for Curing Concrete.”
17. ASTM C 311, “Methods of Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete.”
18. ASTM C 330, “Standard Specification for Lightweight Aggregates for Structural Concrete.”
19. ASTM C 494, “Specifications for Chemical Admixtures for Concrete.”
20. ASTM C 567, “Test Method for Unit Weight of Structural Lightweight Concrete.”
21. ASTM C 618, “Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.”
22. ASTM C 989, “Specification for Ground Granulated Blast-Furnace Slag for Use in Concrete and Mortars.”
23. ASTM C 1077, “Standard Practice for Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.”
24. ASTM C 1116, “Standard Specification for Fiber-Reinforced Concrete and Shotcrete.”
25. ASTM C 1218, “Sampling and Testing for Water Soluble Chloride Ion in Concrete and Concrete Raw Materials.”

E. American Welding Society (AWS):

1. AWS D1.1, “Structural Welding Code-Steel.”
2. AWS D1.4, “Structural Welding Code-Reinforcing Steel.”

F. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP, “Manual of Standard Practice.”

G. Prestressed Concrete Institute (PCI):

1. PCI MNL 116, “Manual for Quality Control for Plants and Production of Precast Prestressed Concrete Products.”
2. PCI MNL 117, “Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products.”

3. PCI MNL 120, “Design Handbook Precast Prestressed Concrete."
4. PCI MNL 122, “Architectural Precast Design Handbook.”
5. PCI MNL 129, “Parking Structures-Recommended Practice for Design and Construction.”
6. PCI “Code of Standard Practice for Precast Concrete.”

H. Contractor shall have following ACI publications at Project construction site:

1. ACI SP-15, “Standard Specifications for Structural Concrete ACI 301-96 with selected ACI and ASTM References.”
2. ACI 302.1R, “Guide for Concrete Floor and Slab Construction.”
3. ACI 305R, “Hot Weather Concreting.”
4. ACI 306.1, “Standard Specification for Cold Weather Concreting.”

I. 2010 California Building Code (CBC).

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store all formwork and formwork materials clear of ground, protected, to preclude damage.

B. Deliver reinforcement to Project site bundled, tagged and marked. Use tags indicating bar size, lengths, and other information corresponding to markings shown on placement diagrams.

C. Store concrete reinforcement materials at site to prevent damage and accumulation of dirt or excessive rust.

D. Concrete transported by truck mixer or agitator shall be completely discharged within one and one half-hours (one hour for hot weather concreting) after water has been added to cement or cement has been added to aggregates.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on Drawings.

1. Use overlaid plywood complying with U.S. Product Standard PS-1 “A-C or B-B High Density Overlaid Concrete Form,” Class 1.
2. Use plywood complying with U.S. Product Standard PS-1 “B-B (Concrete Form) Plywood,” Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.

B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.

C. Form Coatings: Provide commercial formulation form-coating compounds with a maximum VOC of 350 grams/liter that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces, including but not limited to water-curing, curing compound, stains or paints.

D. Form Ties: Factory –fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection and to prevent spalling concrete upon removal. Provide units that will leave no metal closer than 1.5 in. to exposed surface.

1. Provide ties that, when removed, will leave holes not larger than 1-in. diameter in concrete surface.

E. Chamfer strips: Wood, metal, PVC, or rubber strips. 0.75” by 0.75” min. unless noted otherwise.

F. Nails for P-T Anchors: Stainless steel ring nails, Clendenin Brothers, Baltimore, MD.

2.2 STEEL REINFORCEMENT

A. Provide in Bid 10 additional tons of placed reinforcement bars or welded wire reinforcement for inclusion in Project as Engineer directs. Return cost of unused portion to Owner at unit price stated on Bid Form. Submit to Engineer breakdown of use each month.

B. Reinforcement Bars: ASTM A 615, deformed, yield strength: as noted on Drawings.

C. Post-tensioned Reinforcement: See Section “Unbonded Post-Tensioned Concrete.”

D. Low-Alloy-Steel Reinforcing Bars: ASTM A 706, deformed.

E. Steel Bar Mats: ASTM A 184, assembled with clips.

1. Steel Reinforcement: ASTM A 615, Grade 60, deformed bars.
2. Steel Reinforcement: ASTM A 706, deformed bars.

F. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

1. Welded wire reinforcement: provide in mats only. Roll stock prohibited.

2.3 REINFORCEMENT ACCESSORIES

A. Bar supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports according to CRSI’s “Manual of Standard Practice” from all plastic of greater compressive strength than concrete, and as follows:

1. In manner acceptable to Engineer solely, bar and welded wire reinforcement supports shall be color-coded to visually differentiate supports by height and shall be fabricated to resist overturning during construction operations.
2. For slabs on grade, use supports with sand plates or horizontal runners where base materials will not support chair legs. All supports shall have sufficient surface area in contact with grade so that they shall not allow clearance loss when reinforcement installed or concrete placed.
3. For concrete surfaces exposed to view where bar supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
4. Chairs shall be sized and spaced to prevent cover loss during construction operations.
5. Acceptable manufacturers:

    a. Aztec Concrete Accessories, Inc.
    b. General Technologies, Inc.
    c. Approved product similar in design, construction, and performance.

6. For welded wire reinforcement, provide continuous bar supports spaced at 2' o.c., maximum."

B. For mechanical tension splices of reinforcement:

1. Use Barsplice Products, Inc., Bar-Grip or Grip-Twist, Extender Coupler NMB Splice Sleeve, or Erico LENTON Splices.
2. All splices to develop 125% of specified yield strength of bars, or of smaller bar in transition splices. Where indicated on drawings, Type 2 splice shall develop in tension the lesser of 95 percent of the estimate tensile strength or 160 percent of specified yield strength of the bar.

C. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.

2.4 MATERIALS

A. Ready Mixed Concrete: Obtain concrete from plant with current certification from:

1. Concrete Materials Engineering Council.
2. California Department of Transportation.
3. National Ready Mixed Concrete Association.
4. Prestressed Concrete Institute.

B. Portland Cement (ACI 301, Section 4 header "Cementitious Materials"):

1. Portland cement, Type I or Type I/II ASTM C 150. Use one cement supplier throughout project. No change in brand or supplier without prior written acceptance from Engineer.

C. Fly Ash:

1. Permitted in all parts of structure.
2. ASTM C 618, Class F, except maximum loss on ignition: 3%. Maximum percent retained on #325 sieve: 28%. Maximum water requirement, stated as percentage of control: 100%.
3. Testing: ASTM C311.
4. Percentage of fly ash in mix design shall be by weight, not by volume. Water/cement ratio will be calculated as water/cementitious (total cement and fly ash) ratio.
5. If project contains post-tensioned members, see Section "Unbonded Post-Tensioned Concrete" for high early strength requirements for concrete to be post-tensioned.
6. If strength varies from value specified by more than specified tolerances, Engineer or designated representative shall reject that concrete.
7. Submit all fly ash concrete mix designs per ACI 301.

D. Normal Weight Aggregates (ACI 301, Section 4 header "Aggregates"):

1. Normal weight concrete aggregates:

   a. Coarse aggregate: Crushed and graded limestone or approved equivalent conforming to ASTM C33 except as noted here, minimum class designations as listed below:

      1) Below grade construction: Class 1M.
      2) Walls not exposed to public view: Class 3M.
      3) Walls exposed to public view: Class 5M.
      4) Slabs on grade: Class 4M.
      5) All other concrete: Class 5M.

   b. No deleterious materials such as, but not limited to, chert or opaline.
   c. Fine aggregate**:** Natural sand conforming to ASTM C 33 and having preferred grading shown for normal weight aggregate in ACI 302.1R, Table 4.2.1.
2. Coarse aggregate: Nominal maximum sizes indicated below, conforming to ASTM C 33, Table 2:

   a. Footings: Size number 57 or 357**.**
   b. All other members: Size number 67.

E. Water: Potable and complying with ASTM C 94, Table 3.

F. Storage of Materials (ACI 301, Section 4 header "Materials Storage and Handling").

2.5 ADMIXTURES

A. Use water-reducing admixture, mid-range water-reducing admixture or high-range water-reducing admixture (superplasticizer) in concrete as required for placement and workability.

B. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg. F.

C. Use high-range water-reducing admixture (HRWR) in pumped concrete, and for concrete with water/cementitious ratio of less than or equal to 0.45. Use high-range or mid-range water-reducing admixtures in pumped concrete and normal or mid-range water reducing admixtures for concrete with water/cementitious ratios greater than 0.45.

D. Only admixture manufacturers listed acceptable. Do not submit alternate manufacturers.

E. Concrete supplier and manufacturer shall verify via trial mixes and certify compatibility (no effect on workability, strength, durability, etc.) of all ingredients in each mix design. Use admixtures in strict accordance with manufacturer's recommendations.

F. Prohibited Admixtures: Calcium chloride or admixtures containing more than 0.15% chloride ions, by weight of admixture, are not permitted. Additionally, each admixture shall not contribute more than 5 ppm, by weight, of chloride ions to total concrete constituents.

G. Normal Range Water-Reducing Admixture: ASTM C 494, Type A.

1. Products: Subject to compliance with requirements, provide one of following:

a. "Eucon Series," Euclid Chemical Co.
b. "Pozzolith Series," or "Polyheed Series," Master Builders, Inc.
c. "WRDA Series," W.R. Grace & Co.
d. "Plastocrete Series" and "Plastiment Series," Sika Corporation.
e. Approved product similar in design, construction, and performance.

H. Mid Range Water-Reducing Admixture: ASTM C 494, Type A.

1. Subject to compliance with requirements, provide one of following:

a. "Eucon MR" or "Eucon X-20," Euclid Chemical Co.
b. "Daracem Series" or "MIRA 70," W.R. Grace & Co.
c. "PolyHeed Series," BASF Construction Chemicals.
d. "Sikament AFM" or "Sikament 686" Sika Corporation.
e. Approved product similar in design, construction, and performance.

I. High Range Water-Reducing Admixture (Superplasticizer): ASTM C 494, Type F.

1. Products: Subject to compliance with requirements, provide one of following:

a. "Eucon 37" or "Eucon SP-Series" or "Plastol Series," Euclid Chemical Co.
b. "Daracem Series" or "ADVA Series," W.R. Grace & Co.
c. "Rheobuild 1000", "PS 1466" or "Glenium Series," BASF Construction Chemicals.
d. "Sikament Series" or "ViscoCrete Series," Sika Corporation.
e. Approved product similar in design, construction, and performance.

J. High Range water reducing retarding (superplasticizer), ASTM C 494 Type G:

1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon 537 or RD2,” Euclid Chemical Co.
b. “Daracem 100,” W.R. Grace & Co.
c. “Sikament Series,” Sika Corporation.
d. Approved product similar in design, construction, and performance.

K. Non-Chloride, Non-Corrosive Water-Reducing, Accelerating Admixture: ASTM C 494, Type C or E.

1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon AcN-Series,” “Accelguard 80,” “Accelguard NCA,” or “Accelguard 90,” Euclid Chemical Co.
b. “DCI,” “PolaraSet,” “Lubricon NCA,” or “Gilco,” W.R. Grace & Co.
c. “Pozzutec 20+” or “Pozzolith NC 534,” BASF Construction Chemicals.
d. “Sika Set NC,” “Plastocrete 161 FL” or “Sika Rapid-1,” Sika Corporation.
e. Approved product similar in design, construction, and performance.

L. Water-Reducing, Retarding Admixture: ASTM C 494, Type D or B.

1. Products: Subject to compliance with requirements, provide one of following:

a. “Eucon Retarder-75” or “Eucon W.O.” Euclid Chemical Co.
b. “Daratard-17” or “Recover,” W.R. Grace & Co.
c. “Pozzolith Series” or “Delvo Series,” BASF Construction Chemicals.
d. “Plastiment Series” or “Plastocrete Series,” Sika Corporation.
e. Approved product similar in design, construction, and performance.

M. Shrinkage Reducing Admixture:

1. Design requires using materials with combined shrinkage characteristic of 0.04% maximum at 28 days. Proposed concrete mix designs, using actual aggregates, admixtures and cement of the proposed mix for Project as detailed herein and in Drawings, shall meet criteria. Submit ASTM C 157 (may be modified by curing period duration) results for at least 3 specimens. Each test takes 28 days minimum. Begin tests as soon as possible so final test results available for submittal to Engineer.
2. Products: Subject to compliance with requirements, provide one of following:

a. If calcium nitrite is present in the original concrete mixture:

1) “Eclipse Plus,” W.R. Grace & Co., Cambridge, MA.

b. If calcium nitrite is not present in the original concrete mixture:

1) “Eucon SRA,” Euclid Chemical Company, Cleveland, OH.
2) “Eclipse Plus,” W.R. Grace & Co., Cambridge, MA.
3) “Tetraguard AS 20,” BASF Construction Chemicals.

4) "Sika Control 40," Sika Corporation.
5) "SRA-157," Russ Tech Admixtures, Inc.
6) Approved product similar in design, construction, and performance.

2.6 FIBER REINFORCEMENT:

A. Polypropylene fibers for plastic shrinkage control in concrete members.

1. Products: Subject to compliance with requirements, provide one of the following:

a. "Boral Fibers," Boral Material Technologies.
b. "Fiberstrand 100," Euclid Chemical Co.
c. "Mighty-Mono," Forta Corp.
d. "Polymesh," General Resource Technology.
e. "Grace Fibers," or "Grace Microfibers," W.R. Grace & Co., Inc.
f. "Durafiber," Industrial Systems, Ltd.
g. "Stealth," Synthetic Industries, Inc.
h. Approved product similar in design, construction, and performance.

2. Additional requirements:

a. Collated fibrillated materials: Dosage rate 1.0 lb/cu. yd. of concrete minimum, containing at least 3 million individual fibers.
b. Multifilament (microfilament) fibers: Dosage rate 0.5 lb/cu. yd. of concrete minimum, containing at least 25 million individual fibers. Minimum length 0.75 in.
c. Meet requirements of ASTM C 1116, "Standard Specification for Fiber-Reinforced Concrete and Shotcrete," designation Type III, 4.1.3.
d. Meet minimum plastic shrinkage crack reduction of 70% when tested in accordance with ICBO ES, Appendix B (7-92).

B. Use shall not change water requirement of mix. Slump loss due to addition of fiber shall be off-set by addition of superplasticizer.

C. Conform to manufacturer's recommendations for quantity of fiber. See paragraph "Additional Requirements" above for minimums.

D. See Drawings for amount and use locations.

E. Fiber manufacturer or approved distributor: Provide services of qualified representative at pre-construction meeting, concrete pre-installation meeting and first concrete placement containing fibers.

2.7 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

1. Evaporation Retarder:

a. Cimfilm; Axim Concrete Technologies.
b. Aquafilm; Conspec Marketing & Manufacturing Co., Inc.
c. Eucobar; Euclid Chemical Co.
d. E-Con; L&M Construction Chemicals, Inc.
e. Confilm; Master Builders, Inc.
f. SikaFilm; Sika Corporation.
g. Sure-Film (J-74); Dayton Superior Corporation.
h. "EVRT", Russ Tech Admixtures, Inc.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Curing Compound (VOC Compliant, less than 350 g/l): Comply with ASTM C 309, Type 1, Class A or B. Moisture loss shall be not more than 0.55 Kg/m^2 when applied at 200 sq. ft/gal. Manufacturer's certification is required. Silicate based compounds prohibited.

1. Subject to project requirements provide one of the following products:

a. "Kurez DR VOX" or "Kurez W VOX," Euclid Chemical Company.
b. "RxCure WB," or "RxCure VOC" or W.B. Cure VOC." Conspec Marketing & Manufacturing.
c. "Masterkure 200W," Master Builders, Inc.
d. Approved product similar in design, construction, and performance.

2. Additional requirement: With product submittal provide plan and procedures for removal of residual curing compound prior to application of sealers, coatings, stains, pavement markings and other finishes.

2.8 RELATED MATERIALS

A. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

B. Reglets: Fabricate reglets of not less than 0.0217-inch- thick galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

C. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

D. Mechanical and chemical anchors shall be manufactured by Hilti Fastening Systems, Tulsa Oklahoma, ITW Ramset/Red Head, Wood Dale, IL, or accepted equivalent.

Anchor bolt composition shall be from one or more of carbon steel and stainless steel, lead, Zamac alloy, nylon, plastic, polypropylene, and jute fibre.

1. Carbon steel anchors shall be either zinc plated in accordance with ASTM B 633, or hot-dipped galvanized in accordance with ASTM A-153-78. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
2. Stainless steel anchors shall be manufactured from ASTM A303, A304, or A306 stainless steel. Provide mill test reports and manufacturer's quality control certification upon Engineer's request.
3. Plastic, lead, or Zamac alloy anchors shall not be used for overhead applications Chemical anchors shall not be used to resist pullout forces in overhead and wall installations unless proper consideration is given to fire conditions. For chemical anchors, consult with manufacturer's engineer.
4. Safety Factors: Static loads 4:1 minimum. Static load safety factors shall be per manufacturer's published data. Critical load (vibratory, overhead, etc. or more) safety factors shall be 10:1 minimum. Provide test reports for manufacturers published load data upon Engineer's request.

    a. If necessary for purposes of determining tensile and/or shear capacity in questionable base material, testing shall be done prior to actual anchor installation. A maximum of five tension and/or shear tests shall be performed by manufacturer's engineer. Anchors shall be proof loaded in tension and/or shear to assure that working load capacity is within specified allowable load limit as published by manufacturer.

5. Anchor spacing and edge distance per manufacturer's limits. Loading and cluster spacing shall be as established by minimum industry standards for anchors except as follows: Anchor loading, cluster spacing and edge distances shall be as published in manufacturer's literature. Consult with manufacturer's engineer for specific requirements.
6. Anchor installation shall be as required by manufacturers written instructions.

E. Inserts and Coil Rods:

1. Yield strength: 65,000 psi minimum.
2. Galvanizing: Where indicated, electrodeposited zinc coating, ASTM B 633, Service condition 1, Type III.
3. Acceptable manufacturers:

    a. Dayton/Richmond Concrete Accessories, Inc., Miamisburg, OH.

4. Details shown on drawings are based on Dayton/Richmond Screw Anchor Co., Inc. products and their respective capacities. Other products may be used only if contractor submits calculations, sealed by professional engineer or structural engineer licensed in California, substantiating strength of connection with other product. Calculations are subject to Engineer's acceptance before fabrication is to proceed.

F. Joint Filler:

1. Joint filler in slabs and curbs: Asphalt impregnated fiber board; as shown on Drawings. Acceptable products:

    a. "Flexcell," Knight-Celotex Corp.
    b. "Fibre Expansion Joint," W.R. Meadows, Inc.
    c. Approved product similar in design, construction, and performance.

2. Joint filler used vertically to isolate walls from columns or other walls: White molded polystyrene beadboard type.
3. Joint cover used to bridge gap between columns and grade walls, retaining walls, or basement walls: Minimum width: Gap width plus 4 in. For gaps over 3 in. wide, protect cover with protection board sized to span gap satisfactorily. Acceptable products:

    a. "Sealtight Premoulded Membrane Vapor Seal," W.R. Meadows, Inc., Elgin, Illinois.
    b. Approved product similar in design, construction, and performance.

G. Slide Bearing System at Expansion Joints:

1. Provide slide bearing system as shown and detailed on Drawings:

    a. Slab and plank bearings shall be ultrahigh molecular weight, high-density polyethylene resin: Acceptable material:

        1) "Korolath PE," Korolath Corporation, Hudson, Mass.
        2) "Tivar-1000," Poly-Hi/Menasha Corporation, Fort Wayne, IN.
        3) "UHMW Econ-o-Shim," Deslausiers, Inc., Bellwood IL.
        4) Approved product similar in design, construction, and performance.

2.9 REPAIR MATERIALS

A. Acceptable repair materials:

1. Bonding Admixture:

    a. "SBR Latex" or "Flexcon," Euclid Chemical Co.
    b. "Acryl 60," Thoro, a Division of Degussa Building Systems.
    c. "Sika Latex R," Sika Corporation.
    d. Approved product similar in design, construction, and performance.

2. Epoxy Adhesive: 2 component, 100% solids, 100% reactive compound or Epoxy-Cement suitable for use on dry or damp surfaces:

    a. "Euco Epoxy #452 Series," "Corr-Bond," or "Eucopoxy Injection Resin," Euclid Chemical Co.
    b. "Concresive Liquid LPL," MBT Protection & Repair, A Division of Degussa Building Systems.
    c. "Sikadur Hi-Mod," or "Armatec 110," Sika Corp.
    d. Approved product similar in design, construction, and performance.

3. Patching Mortar: Polymer-modified cementitious mortar.

    a. “Thin Top Supreme,” or “Vericoat Supreme,” Euclid Chemical Corp.
    b. “EMACO R Series,” MBT Protection & Repair, a Division of Degussa Building Systems.
    c. “SikaRepair 222,” Sika Corp.
    d. Approved product similar in design, construction, and performance.

4. Repair Topping: Self-leveling, polymer-modified high strength topping

    a. “Thin Top Supreme,” Euclid Chemical Co.
    b. “Mastertop Topping 112, MBT Protection & Repair, A Division of Degussa Building Systems.
    c. “SikaTop 111 Plus,” Sika Corp.
    d. Approved product similar in design, construction, and performance.

5. Repair Topping for areas greater than 1-inch depth: Flowable one-part, high strength silica fume modified repair mortar with 0.375” aggregate. The product shall achieve 9000 psi at 28 days at a 9-inch slump:

    a. “Eucocrete,” Euclid Chemical Co.
    b. “SikaTop 111 Plus”, Sika Corp.
    c. “EMACO S77CI,” MBT Protection & Repair, a Division of Degussa Building Systems.

        1) For depths > 1.5 in. use preplaced aggregate.

    d. Approved product similar in design, construction, and performance.

2.10 CONCRETE MIXES

A. Prepare design mixes for each season, as well as each type and strength of concrete determined by either laboratory trial mix or field test data bases, as follows:

1. Proportion normal-weight concrete according to ACI 211.1 and ACI 301.
2. Be prepared to use a different mix design as the season warrants.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the laboratory trial mix basis.

C. Requirements for normal-weight concrete mix are shown on Drawings:

1. Compressive strength
2. Slump
3. Water-cementitious materials ratio

D. Supplementary cementitious Materials: Maximum weight of fly ash or natural pozzolans included in concrete shall not exceed percentages of total weight of cementitious materials as follows:

1. Fly Ash or other pozzolans conforming to ASTM C 618: 25 percent.

E. Chloride Ion Content of Mix:

1. Water soluble chloride ion content of concrete shall not exceed 0.06% by weight of cement for pre-stressed concrete and 0.15% for reinforced concrete. (ACI 318 Chapter 4 Table "Maximum Chloride Ion Content for Corrosion Protection of Reinforcement") Test to determine chloride ion content shall conform to ASTM C 1218.
2. Concrete chloride ion content shall be determined by Testing Agency prior to placement. Cast samples from current production of concrete mix proposed for superstructure.
3. Concrete not meeting the requirements of paragraph "Water soluble chloride ion content of mix…" above, shall contain appropriate amount of calcium nitrite. Concrete supplier shall provide laboratory test results showing the amount of excess chloride ion content in the concrete mixture contributed by the aggregates. For each pound of chloride ion in excess of the amount allowed, mix shall contain calcium nitrite (30%, +/- 2%, solids content) on one-to-one basis (one gallon of calcium nitrite for one lb of excess chloride ion). Maximum of 1.5 lb of chloride ion per cubic yard may be offset in this manner.

F. Alkali content of mix shall not exceed 5 lb/cu. Yd of (Na_20 equivalent) cement.

G. Synthetic Fiber (collated fibrillated or monofilament): Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1 lb/cu. Yd.

H. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing admixture or high-range water-reducing admixture (Super-plasticizers), as required, for placement, workability, and when required, increased flowability.
2. Consider using water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use high range water-reducing admixture in pumped concrete, concrete for parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio of 0.45 or less. Use standard or mid-range ASTM Type A water reducing admixture for concrete with water-cementitious materials ratio greater than 0.45.

I. Slump (ACI 301, Part 4 header "Slump"):

1. Maximum slump for concrete is indicated on Drawings. Where field conditions require slump to exceed that shown, increased slump shall be obtained by use of superplasticizers only, and Contractor shall obtain written acceptance from Engineer who may require an adjustment to mix.
2. All concrete containing high-range water-reducing admixture (superplasticizer) shall have a verified initial slump of 2– 3 in. Final slump after the addition of the superplasticizer shall be 6–9 in. as required by the contractor to properly place the concrete. Before permission for plant addition of superplasticizer to be granted by Engineer, fulfill following requirements:

a. Submit letter from testing laboratory which developed original mix designs(s), for each superplasticized mix design, certifying volume of mix wa-

ter which will produce specified slump and water/cement ratio, taking into account aggregate moisture content.

b. Submit plant computer printout of mix content for each truckload of superplasticized concrete with delivery of that truckload. Mix water volume greater than that certified shall be cause for concrete rejection.
c. Over-retarding or crusting of flatwork surface: cause for concrete rejection.
d. Segregation or too short superplasticizer life due to superplasticizer type or under-dosing: cause for concrete rejection.

J. Shrinkage (Length Change):

1. Determine length change of hardened concrete test specimens in accordance with ASTM C 157, except as noted in paragraph below. Existing test data from previous project with same materials may be acceptable.
2. Test specimens shall be moist cured, including period in molds for 7 days. Then store specimens in air for period of 28 days.
3. Utilize concrete materials and mix proportions submitted, for use in floor slab beam, in accordance with Part 1 Article “Submittals”.
4. Report length change of specimens after periods of air drying after curing of 4, 7, 14, 21, and 28 days.
5. Average length change at 28 days shall be limited to 0.04%, unless otherwise accepted by Engineer. Values exceeding 0.04% shall be rejected.

K. Engineer’s acceptance of mix design shall not relieve Contractor from responsibility for any variation from requirements of Contract Documents unless Contractor has in writing called Engineer’s attention to each such variation at time of submission and Engineer has given written approval of each such variation.

L. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, as accepted by Engineer. Laboratory test data for revised mix design and strength results shall be submitted to and accepted by Engineer before using in work.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI’s “Manual of Standard Practice.”

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94, and furnish batch ticket information. Truck mixing prohibited. Mix at plant.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, amount of water introduced.

2.13 TOOLS

A. Slab Jointing

1. Concrete groovers: For tooled joints in concrete:

a. For concrete not exceeding 4 in. thickness, use groover which provides 1 in. deep v-cut with 0.5 in. surface width and 3/16 in. to 1/4 in. edge radius.
b. For concrete exceeding 4 in. thickness, use groover which provides 1.5 in. deep v-cut with ½ in. surface width and 3/16 in. to ¼ in. edge radius.

2. Saw Cut Joints:

a. Acceptable tool: “Soff-Cut Saw Model 310” or “Model G2000,” Soff-Cut International, Corona, CA.

1) Cut joint as soon as concrete will support weight of operator and saw without deforming.
2) Joint shall be 1 in. deep. Do not cut reinforcement.
3) Extend joint to adjacent vertical surface within 30 minutes of cutting.
4) Retool or grind sawcut joint before installing sealant to provide equivalent dimensions, shape and volume as joint obtained by tooled joint. Surface width shall be 0.5 in. with 3/16 to 1/4 in. edge radius.
5) All joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

PART 3 - EXECUTION

3.1 FORMWORK

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

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

1. Footings:

a. Footings other than those to receive masonry construction: Variation of bearing surface from specified elevation: Plus or minus 0.5 in.
b. Footings to Receive Masonry Construction:

1) Variation of center from specified location in plan: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.
2) Variation of bearing surfaces for specified elevation: Plus or minus 0.25 in. in any 10 ft but not to exceed plus or minus 0.5 in.

2. Piers, Columns, Walls, Beams, and Slabs:

a. Variation in cross-sectional dimensions of piers, beams and columns and in thickness of walls and slabs: 12 in. or less: Plus 0.375 in., minus 0.25 in. Greater than 12 in.: Plus 0.5 in., minus 0.375 in.
b. Variation in elevation from specified elevation for piers, columns and walls: Plus or minus 0.5 in.

C. Void Forms:

1. Prepare ground surface on level plane.
2. Protect all forms from moisture prior to concrete placement.
3. Install all forms and accessories in accordance with manufacturer's recommendations.
4. Protect all forms from puncture and moisture during concrete placement including accessories such as taped joints, seam pads and end caps.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical. Kerf wood inserts for forming keyways, reglets, recesses, and the like, for easy removal.

1. Do not use rust-stained steel form-facing material.

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

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

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

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

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

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

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

3.2 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor bolts, accurately located, to elevations required.
2. Install reglets to receive top edge of foundation sheet waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork, for sides of beams, walls, columns, and similar parts of the Work, that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete provided concrete is hard enough to not be damaged by form-removal operations and provided curing and protection operations are maintained.

B. Leave formwork, for beam soffits, joists, slabs, and other structural elements, that supports weight of concrete in place until concrete has achieved the following:

1. At least 70 percent of 28-day design compressive strength.
2. For post-tensioned concrete, formwork shall remain in place until post-tensioning has been completed. Do not place additional loads on structure until concrete has been properly reshored.
3. Determine compressive strength of in-place concrete by testing representative field- or laboratory-cured test specimens according to ACI 301.
4. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

C. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

D. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301, and recommendations in ACI 347R for design, installation, and removal of shoring and reshoring.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.5 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

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

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain specified concrete cover. Do not tack weld crossing reinforcing bars.

1. Shop- or field-weld reinforcement according to AWS D1.4, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded wire reinforcement in longest practicable lengths on continuous bar supports spaced at 2' o.c., maximum. Lap edges and ends of adjoining sheets per ACI 318 and as follows:

1. Length of over lap measured between outermost cross wires of each fabric shall not be less than one spacing of cross wires plus two inches nor less than one and one-half times the development length nor 6" minimum where development length is calculated per section 12.8 of ACI 318.
2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

F. Splices:

1. Provide standard reinforcement splices by lapping ends, placing bars in contact, and tying tightly with wire. Comply with requirements of ACI 318 for minimum lap of spliced bars.
2. For mechanical tension splices of reinforcement:

a. Column bar lengths shall not exceed 30 ft between splices. In any bar, no splices shall occur at any floor level.
b. Exercise care to assure that no reduction of cross-sectional area of reinforcement occurs.
c. For all mechanical splices, perform splicing in strict accordance with manufacturer's requirements and instructions.
d. Stagger splices in adjacent bars.
e. Except where shown on Drawings, welding of reinforcement prohibited without prior written authorization by Engineer.

3. Compression splices: Mechanically coupled splices in accordance with ACI 318, Chapter 12.
4. Welded wire reinforcement shall not extend through contraction joints.

3.6 JOINTS

A. Joints in Concrete (ACI 301, Section 5):

1. Construction, control and isolation joints are located and detailed on Drawings:

a. Tool joints at time of finishing. Tool: Part 2 Article "Tools."
b. Saw Cut Joints: Prohibited.
c. Soff-Cut Joints: Allowable in slab-on-grade only.

1) Cut joint as soon as concrete will support weight of operator and saw without deforming.
2) Joint shall be 1.5 in. deep. Do not cut reinforcement.
3) Extend joint to adjacent vertical surface within 30 minutes of cutting.
4) If sealant is to be installed, retool or grind saw cut joint before installing sealant to provide equivalent dimensions, shape, and volume as joint obtained by Goldblatt Groover #06-314-M7.
5) All sealed joints subject to acceptance by sealant installer. Rework rejected joints until acceptable to sealant installer.

d. Isolation joints: Interrupt structural continuity resulting from bond, reinforcement or keyway.
e. Construction and control joints in walls: Space joints at 18 ft on center unless smaller spacing is shown on Drawings.
f. Construction or control joints in floor slabs on grade: Maximum slab area controlled by jointing 324 sq ft. Space joints at 18 ft on center maximum unless different spacing is shown on Drawings. Maximum aspect ratio = 1.5:1.0.
g. Coordinate configuration of tooled joints with control joint sealants.

B. Provide keyways at least 1-1/2 in. deep in construction joints in walls and slabs. Accepted bulkheads designed for this purpose may be used for slabs.

C. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints except as otherwise indicated. Do not continue reinforcement through sides of strip placements.

D. Use bonding grout, containing the specified bonding admixture, on existing concrete surfaces that will be joined with fresh concrete.

E. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.

1. Joint filler and sealant materials are specified in Division 07 Sections of these Specifications.

F. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown.

1. Tool contraction joints.
2. If joint pattern not shown, provide joints not exceeding 18 ft in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays).

G. Joint sealant material is specified in Division 07 Sections.

3.7 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Do not add water to concrete during delivery, at Project site, or during placement, unless approved by Engineer/Architect.

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

D. Deposit concrete in forms in horizontal layers no deeper than 24 inches and in a manner to avoid inclined construction joints. Place each layer while preceding layer is still plastic, to avoid cold joints.

1. Consolidate placed concrete with mechanical vibrating equipment. Use equipment and procedures for consolidating concrete recommended by ACI 309R.
2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations no farther than the visible effectiveness of the vibrator. Place vibrators to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete

embedment of reinforcement and other embedded items without causing mix constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using highway bull floats or darbies to form a uniform and open-textured surface plane, free of humps or hollows, before excess moisture or bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

F. 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, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Use only the specified non-corrosive accelerator. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

G. 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 below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched. Remove fins and other projections exceeding ACI 347R limits for class of surface specified.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and

patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch in height.

1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

C. Rubbed Finish: Apply the following to smooth-formed finished concrete:

1. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix one part Portland cement and one part fine sand with a 1:1 mixture of bonding agent and water. Add white Portland cement in amounts determined by trial patches so color of dry grout will match adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.9 FINISHING FLOORS AND SLABS

A. Flatwork in Parking and Drive Areas (SWIRL Finish, ACI-301, Section 5 header “Float Finish”):

1. Begin bull floating after bleeding of water through surface of concrete has been completed and water sheen has disappeared from surface of concrete and concrete has stiffened sufficiently to allow operation (ACI 302.1R, Chapter 8).
2. Give slab surfaces rough, swirl texture finish. Swirl ridges shall not be allowed to exceed 0.25 in. in height. Texture shall be as accepted by Engineer from sample panels. No refloating required.
3. Finishing tolerance: ACI 301, Section 5 header “Measuring Tolerances for Slabs” and ACI 117, paragraph 4.5.7: The gap at any point between the straightedge and the floor (and between the high spots) shall not exceed 0.5 in. In addition, floor surface shall not vary more than plus or minus 0.75 in. from elevation noted on Drawings anywhere on floor surface.
4. Before installation of flatwork and after submittal, review, and approval of concrete mix design, Contractor shall fabricate two acceptable test panels simulating finishing techniques and final appearance to be expected and used on Project. Test panels shall be minimum of 20 ft. by 30 ft. in area and shall be reinforced and cast to thickness of typical parking and drive area wearing surface in Project. (Maximum thickness of test panels need not exceed 6 in.) Test panels shall be cast from concrete supplied by similar concrete batch, both immediately after addition of superplasticizer or water-reducing admixture, and at maximum allowed time for use of admixture-treated concrete in accordance with Specifications. Intent of test panels is to simulate both high and low workability mixes, with approximate slump at time of casting of test panels to be 6 in. and 3 in., respectively. Contractor shall finish panels following requirements of paragraphs above, and shall adjust panels finishing techniques to duplicate appearance of concrete surface of each panel. Finished panels (one or both) may be rejected by Engineer,

in which case Contractor shall repeat procedure on rejected panel(s) until Engineer acceptance is obtained. Accepted test panels shall be cured in accordance with Specifications and may be incorporated into Project. Accepted test panels shall serve as basis for acceptance/rejection of final finished surfaces of all flatwork.

5. Finish all concrete slabs to proper elevations to ensure that all surface moisture will drain freely to floor drains, and that no puddle areas exist. This Contractor shall bear cost of any corrections to provide for positive drainage.

B. Flatwork in Stairtowers and Parking Garage floor subject to pedestrian traffic:

1. Concrete surfaces at all walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:

a. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces and “Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)” and ICC A117.1.
b. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:

1) Changes in level of less than ¼ inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
2) Changes in Level between ¼ inch and ½ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
3) Changes in level greater than ½ inch in height are not permitted unless they can be transitioned by means of a ramp with minimum requirements shown on the Drawings.
4) Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.

c. Walkway surfaces shall provide a slip resistant surface.

1) Concrete surfaces shall be troweled and finished to provide a slip resistant finish.
2) Contractor shall provide sample area with slip resistant surface finish.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel-finish concrete surfaces.

3.11 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 with recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft./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. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

    a. Tepid (within 20°F of concrete temperature) 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 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

    a. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.

b. Curing compound prohibited when concrete has specified water-cementitious materials ratio less than 0.40 or air temperature above 80°F. Use moist cure instead.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:

   a. Tepid (within 20°F of concrete temperature) 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 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer recommends for use with floor coverings.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

   a. Apply two separate coats with first allowed to become tacky before applying second. Direction of second application shall be at right angles to direction of first.
   b. Curing compound prohibited when concrete has specified water-cementitious materials ratio less than 0.40 or air temperature above 80°F. Use moist cure instead.

3.12 CONCRETE SURFACE REPAIRS

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

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part Portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than ½ inch in any dimension in solid concrete but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with specified bonding agent. Fill and compact with specified patching mortar before specified bonding agent has dried. Fill form-tie voids with specified patching mortar or cone plugs secured in place with specified bonding agent.
2. Repair defects on surfaces exposed to view by blending white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area on mockup, or if none, at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer/Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, po-pouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of ¼ inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
5. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least ¾ inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mix as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
6. Repair single holes 1 inch or less in diameter with patching mortar. Cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned

concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

7. Repair isolated random cracks that have little movement and single holes not over 1 in. in diameter in accordance with procedures and materials specified in Division 07 Section "Waterproofing System." Receive Engineer's written acceptance of methods and materials selected prior to application.

    a. Repair isolated random horizontal cracks less than 0.01 in. wide, using silane sealer product specified in Section 07100 – part 2 heading "Materials, Concrete Sealer."
    b. Repair isolated random horizontal cracks 0.01 in. to less than 0.03 in. wide, using methylmethacrylate product specified in Section 07100 – part 2 heading "Materials, High Molecular Weight Methylmethacrylate."
    c. Repair isolated random horizontal cracks 0.03 in. to 0.06 in. wide: route and seal with specified sealant product in Section 07100 – part 2 heading "Materials, Concrete Control And Construction Joint Sealant System."
    d. Repair isolated random vertical cracks more than 0.01 in. wide, using epoxy injection product specified in part 2 heading "Related Materials" of this section.

E. Perform structural repairs of concrete, subject to Engineer/Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Engineer/Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Owner will employ a testing laboratory to perform tests and to submit test reports.

B. Concrete Compressive Strength:

1. Mold test cylinders in accordance with ASTM C 31 and test in accordance with ASTM C 31 as follows:

    a. Take minimum of six cylinders (eight for post-tensioned cast-in-place concrete) for each 150 cu yd or fraction thereof, of each mix design of concrete placed in any one day.
    b. Additional cylinders shall be taken under conditions of cold weather concreting per Part 3 heading "Concrete Curing and Protection."
    c. At Contractor's option and cost, cylinders may be taken to verify concrete strength prior to form removal.
    d. Testing Agency: Provide and maintain site cure box for cylinders.

2. Sample plastic concrete for testing at point of final placement, in accordance with ASTM C 172. Engineer will select sampling locations which may include points where plastic concrete has already been screeded and floated. Sample concrete for test cylinders to be used to verify concrete compressive strength for post-tensioning as near as possible to actual tendon anchorages.

3. Cover specimens properly, immediately after finishing. Protect outside surfaces of cardboard molds, if used, from contact with sources of water for first 24 hours after molding.
4. Cure test cylinders per ASTM C 31 as follows:

    a. To verify compressive strength prior to post-tensioning or form removal or for additional test cylinders required due to cold weather concreting conditions:

        1) Store test specimens on structure as near to point of sampling as possible and protect from elements in same manner as that given to portion of structure as specimen represents.
        2) Transport to test laboratory no more than 4 hours before testing. Remove molds from specimens immediately before testing.

    b. To verify 28-day compressive strength:

        1) During first 24 hours after molding, store test specimens under conditions that maintain temperature immediately adjacent to specimens in range of 60 to 80 degrees F. and prevent loss of moisture from specimens.
        2) Remove test specimens from molds at end of 20 +/- 4 hours and store in moist condition at 73.4 +/- 3 degrees F. until moment of test. Laboratory moist rooms shall meet requirements of ASTM C 511.

5. Compression test for non-prestressed concrete:

    a. Test 2 cylinders at 7 days.
    b. Test 2 cylinders at 28 days.
    c. Hold 2 cylinders in reserve for use as Engineer/Architect directs.

6. Compression tests for post-tensioned concrete:

    a. Test 2 cylinders immediately before tensioning slabs and 2 cylinders before tensioning beams. Cylinders must be field cured in accordance with paragraph “Cure test cylinders per ASTM C 31….”
    b. Test 2 cylinders at 28 days.

7. Hold 2 cylinders in reserve for use as Engineer directs.
8. Unless notified by Engineer, reserve cylinders may be discarded without being tested after 56 days.

C. Slump Test:

1. Conduct one slump test in accordance with ASTM C 143 per truck load of ready mixed concrete delivered to Project at truck for superstructure concrete.
2. Conduct slump test in accordance with ASTM C143 and ACI 301 for foundation concrete.
3. When high-range water-reducing admixture (superplasticizer) is used, initial slump must be verified by Testing Agency.

D. Report all nonconforming test results to Engineer via fax. Follow up with colored paper copies to flag the non-conformances.

E. Monthly, submit a graph showing distribution of compressive strength test results. Include microwave test results for ≤0.40 concrete.

3.14 EVALUATION AND ACCEPTANCE OF CONCRETE

A. Concrete Compression test will be evaluated by Engineer in accordance with ACI 301. If number of tests conducted is inadequate for evaluation of concrete or test results for any type of concrete fail to meet specified strength requirements, core tests may be required as directed by Engineer.

B. Core tests, when required, in accordance with ACI 301.

C. Should tested hardened concrete meet Specifications, Owner will pay for coring and testing of hardened concrete. Should tested hardened concrete not meet Specifications or should concrete have to be tested because Contractor did not conform to Project specifications, Contractor shall pay for coring and testing of hardened concrete and for any corrective action required for unaccepted concrete.

3.15 ACCEPTANCE OF STRUCTURE

A. Acceptance of completed concrete Work will be according to provisions of ACI 301.

B. “RAPIDLOAD” testing is acceptable, by Structural Preservation Systems, Baltimore, MD.

END OF SECTION 03 30 10

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

I. GENERAL INFORMATION:	
Project:	City:
General Contractor:	
Mix Design Identification No.:	Concrete Grade:
Use (Describe)[1]:	

[1] Footings, interior flatwork, columns, etc.

II. MIX DESIGN PREPARATION:		
Mix Design Based on (Check one): Standard Deviation Analysis: _____ or Trial Mix Test Data: _____		
Design Characteristics:	Density: pcf;	
	Slump ____ in. before superplasticizer	Slump ____ in. after superplasticizer
	Strength: _____ psi (28 day);	

WALKER ACCEPTANCE STAMP

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

III. MATERIALS:		
Aggregates: (size; type; source; gradation report; specification)		
Coarse:		
Fine:		
Other Materials:	Type	Product-Manufacturer (Source)
Cement:		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Water Reducer		
High Range Water Reducer (HRWR / superplasticizer)		
Other(s):		

IV. MIX PROPORTIONS (per yd^3)		
	WEIGHT (lbs.)	ABSOLUTE VOL. (cu. ft.)
Cement:		
Fine Aggregate: (2)		
Coarse Aggregate: (2)		
Flyash, slag, or other pozzolan:		
Silica Fume		
Processed Ultra Fine Fly Ash		
HRM		
Water: (.3)		
Fibers:		
(Other) _____:		

TOTALS:		
NOTES: (2) Based on saturated surface dry weights of aggregates. (3) Includes ALL WATER, including added water and free water contained on aggregates.		

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

V. RATIOS			VI. SPECIFIC GRAVITIES
Water[(1)]	=	lb =	Fine Aggregate:
Cementitious Material[(2)]		lb	Coarse Aggregate:
Fine Agg.	=	lb =	
Total Agg.		lb	

NOTES:
[(1)]Includes ALL water, including added water and free water contained on aggregates.
[(2)]Cementitious materials include cement, fly ash, slag, silica fume, HRM, Processed Ultra Fine Fly Ash or other pozzolan.

VII. ADMIXTURES				
Superplasticizer			_____ oz.	per 100# cement
Water Reducer			_____ oz.	per 100# cement
Retarder	_____ oz.	Per yd^3	_____ oz.	per 100# cement
			_____ oz.	per 100# cement

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

VIII. STANDARD DEVIATION ANALYSIS:	Yes	N/A
(Complete this section only if mix design was developed using standard deviation analysis of previous project test results. If other method was used, check "N/A".)		
Number of Test Cylinders Evaluated:	Standard Deviation:	
Mix Designs Proportioned to Achieve f'cr = f'c + _____ psi		
NOTE: Mix designs shall be proportioned to achieve f'cr equal to or greater than the larger of: f'cr = f'c + 1.34ks [s= calculated standard deviation] or f'cr = f'c + 2.33ks – 500 or f'cr = 0.9f'c + 2.33 ks (for f'c>5,000 psi) (Refer to ACI 301 for increased deviation factor when less than 30 tests are available.)		

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

IX. TRIAL MIXTURE TEST DATA:		Yes	N/A
(Complete this section only if mix design is based on data from trial test mixture(s) batched by testing agency or Contractor. If other method was used, check "N/A".)			
Age (days)	Mix #1 (comp. str.)	Mix #2 (comp. str.)	Mix #3 (comp. str.)
7			
7			
28			
28			
28 day average compressive strength: _____ psi			
DESIGN MIX CHARACTERISTICS			
Slump = _____ in.			
Unit Wet Wt. = _____ pcf		Unit Dry Wt. = _____ pcf	
Mixture shall be proportioned in accordance with ACI 301 section 4.2.3 to achieve average compressive strength for equal to or greater than the larger of one of the following equations: (Less than 3000) f'cr = f'c + 1000 or (3000 to 5000) f'cr = f'c + 1200 or (Over 5000) f'cr + f'c + 700 For post-tensioning projects, see also special requirements for strength required to apply initial post-tensioning.			
ACTUAL MIX CHARACTERISTICS			
Initial Slump = _____ in.		Final Slump _____ in.	
Unit Wet Wt.= _____ pcf.		Unit Dry Wt. = _____ pcf.	

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

X. OTHER REQUIRED TESTS		
Water Soluble Chloride Ion Content of mix:	_____ % (by weight of cement)	ASTM C 1218
Shrinkage (Length Change, Average) per ASTM C157:		
_____% @ 4 days	_____% @ 7 days	_____% @ 14 days
_____% @21 days	_____% @28 days	

XI. Remarks:

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

SUBMITTED BY:

Ready Mix Concrete Supplier Information
Name:
Address:
Phone Number:
Date:
Main Plant Location:
Miles from Project Site:
Secondary or Backup Plant Location:
Miles from Project Site:

My signature below certifies that I have read, understood, and will comply with the requirements of this Section.
Signature_____

Typed or Printed Name

MIX DESIGN SUBMITTAL FORM

Mix #
Job Name:

REQUIRED ATTACHMENTS	
	Coarse aggregate grading report
	Fine aggregate grading report
	Concrete compressive strength data used for standard deviation calculations
	Chloride ion data and related calculations
	Admixture compatibility certification letter
	Shrinkage information per ASTM C157

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SECTION 03 38 17 - UNBONDED POST-TENSIONED CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. In accordance with Contract Documents, provide all materials, labor, equipment, and supervision to fabricate and install all post-tensioning Work. Support bars shall conform to Division 03 Section, "Cast-in-Place Concrete."

B. Related work in other Sections related to Post-Tensioned Concrete:

1. Division 03 Section "Cast-in-Place Concrete.

1.3 SYSTEM DESCRIPTION

A. System described in this Section intended to satisfactorily perform in Southern California and desert southwest region of the United States without long-term distress.

1.4 POST-TENSIONING SUPPLIER PREQUALIFICATION REQUIREMENTS

A. Supplier shall have successfully provided all materials for at least 5 post-tensioning installations in parking structures with structural system similar to Project in previous 5 years.

B. Any Supplier intending to submit bid on post-tensioning work shall submit following to Engineer/Architect for approval not less than 14 calendar days prior to bid date:

1. List of projects cited in paragraph above.
2. Company name, address, and phone number of responsible consulting structural engineering firm for each project and name of individual in company who was primarily responsible for project.
3. Contractor, with name, address and phone number of Project Manager who was responsible for project.
4. Value of post-tensioning subcontract.
5. Quantity of post-tensioning strand used on project.
6. Resume of Professional Engineer/Architect, if known, who will sign and seal shop drawings. If not known at time of Prequalification, submit 2 weeks before submitting Shop Drawings.
7. Resume of Superintendent for Project.
8. Details of anchorages to be provided for Project.

9. Sample of tendon sheathing to be provided for Project (12 in. minimum length).
10. Quality plan for manufacture and installation of post-tensioning system for Project.

C. Prior to bid, Engineer/Architect will accept or reject Supplier based on compliance with criteria referenced herein. Engineer/Architect's decision is final. Engineer/Architect may issue (as necessary) an addendum indicating accepted (prequalified) Suppliers prior to bid date. Contractors shall engage only prequalified Suppliers. Following a qualifications check, Suppliers will receive final notice at or before shop drawing stage. Contractor shall be responsible for delays due to such rejection.

D. Provide post-tensioning strand systems produced in PTI-certified plant, conforming to all material and installation requirements of ACI 301, ACI 318, ACI 423.6, and approved by California Building Code CBC 2010.

E. Compliance with ACI 301 Prestressed Concrete Section, heading “Quality Assurance” required.

F. Prequalified Suppliers:

1. Amsysco, Inc., Romeoville, IL.
2. Dywidag Systems International, USA, Inc., Long Beach, CA.
3. Suncoast Post-Tension, USA, Corporate Office Houston, TX.
4. VSL (Vstructural LLC) Fort Worth, TX.

G. P-T supplier shall have superintendent periodically on site to supervise and ensure consistent and correct installation.

1.5 POST-TENSIONING INSTALLER PREQUALIFICATION REQUIREMENTS

A. Installer shall be accepted in writing by post-tensioning Supplier.

B. Installer shall have successfully performed at least 5 previous post-tensioning installations per heading “Post-Tensioning Supplier Prequalification”.

C. All post-tensioning Work shall be under immediate control of person experienced in this Work. Exercise close check and rigid control of all operations as necessary for full compliance with all requirements. Post-tensioning Contractor's superintendent assigned to Project shall have supervised 5 prior projects of similar magnitude and design, shall be present during all placing and post-tensioning operations, shall exercise close check and control of all operations as required for full conformance to requirements. Superintendent shall be acceptable to Engineer/Architect. Superintendent's failure to ensure full compliance with Specification will result in removal from Project. Engineer/Architect may withdraw acceptance of Superintendent at will.

D. Installers shall be PTI Certified Field Installers prior to starting work on Project, whether or not Installer is prequalified.

1.6 QUALITY ASSURANCE

A. Work shall conform to requirements of ACI 301, ACI 318, and CRSI MSP-2 except where more stringent requirements are shown on Drawings or specified in this Section.

B. Welders and welding procedures shall conform to requirements of AWS D1.1 and AWS D1.4. Welding prohibited except where shown on Drawings or accepted in writing by Engineer/Architect.

C. Inspection of reinforcing steel and post-tensioning reinforcement is required in accordance with California Building Code, Section 1704. Inspection shall be conducted by inspection agency employed by Owner and approved by Engineer/Architect. Prior to placing concrete, inspector shall provide reports in accepted format with copy to Engineer/Architect and Contractor. Inspection agency has authority to reject reinforcement not meeting Contract Documents and accepted Shop Drawings.

D. Submit following information on inspection of nonprestressed reinforcement and post-tensioning reinforcement unless modified in writing by Engineer/Architect:

1. Project name and location.
2. Installer's name.
3. Inspection agency's name, address and phone number.
4. Date and time of inspection.
5. Inspection agency technician's name.
6. Weather data:

    a. Air temperatures.
    b. Weather.
    c. Wind speed.

7. Inspection location within structure.
8. Post-tensioning steel inspection data (including but not limited to):

    a. Tendon size, spacing, cover, drape, grade, fabrication.
    b. Sheathing type, thickness, apparent density, damage, and repair.
    c. Corrosion preventive coating.
    d. Anchorages, sleeves, accessories, protection system.
    e. Support methods and construction sequencing.

1.7 SUBMITTALS

A. Make submittals in accordance with requirements of Division 01 and as specified in this Section.

B. Because Work of Division 03 Sections "Cast-in-Place Concrete" and "Unbonded Post-Tensioned Concrete" are interdependent, Contractor shall have both suppliers review other's Shop Drawings and note any potential interferences. Contractor shall then review both Sections' Shop Drawings against each other and inform Engineer/Architect of any potential interferences.

C. Installation Drawings Include:

1. Numbers and arrangement of post-tensioning tendons.
2. Tendon profiles and method of tendon support. Show beam tendon profiles with side-view drawings of scale sufficient to clearly indicate tendon high and low points.
3. Type, material, density, and thickness of post-tensioning sheathing.
4. Type and chemical analysis of corrosion preventive coating.
5. Type, material, and thickness of post-tensioning sheathing repair tape.
6. Detailing of anchorage devices.
7. Other incidental features.
8. Superintendent qualifications.

D. Submit following information with Shop Drawing submittal:

1. Sealed calculations, prepared under supervision of licensed structural Engineer registered in California. The calculations shall show losses due to anchorage seating, elastic shortening, creep, shrinkage, relaxation, friction, and wobble, used to determine tendon sizes and number. Friction and wobble coefficients shall be in accordance with PTI recommended values unless test data submitted to substantiate lower values.
2. Certified calibration curve for each jack.
3. Post-tensioning tendon and end anchorage sizes.
4. Sample of concrete anchorage assembly.

E. After review, Shop Drawings and data shall not be changed, nor shall construction operations be revised unless resubmitted for acceptance by Engineer/Architect. Engineer/Architect's review of details and construction operations will not relieve Contractor of responsibility for completing Work successfully in accordance with Specifications and within Contract Time.

F. Submit following to Engineer/Architect for review before beginning construction:

1. Post-tensioning experience record of installer who is to perform post-tensioning Work.
2. Certified mill test reports for each coil or pack of strand, containing, as a minimum, following test information:

    a. Heat number and identification.
    b. Ultimate tensile strength.
    c. Yield strength at 1% extension.
    d. Elongation at failure.
    e. Modulus of elasticity.
    f. Diameter and net area of strand.
    g. Type of material.

3. Relaxation losses for low relaxation type material shall conform with ACI 423.6 requirements.
4. Evidence of satisfactory performance on similar projects in United States of America, if strand manufactured outside USA.

5. Results of tests required by ACI 301, Section “Prestressed Concrete,” heading “Quality Assurance.”

G. Inspection Agency, employed by Owner will keep post-tensioning records and submit to Engineer/Architect. Report will document:

1. Calculated elongation, based upon elastic modulus and cross sectional area of tendons used.
2. Actual field elongation of each tendon.
3. Calculated gauge pressure and jacking force applied to each tendon.
4. Actual gauge pressures and jacking forces applied to each tendon.
5. Required concrete strength at time of jacking.
6. Actual concrete strength at time of jacking.
7. Range of allowable elongations for jacking force.
8. Jack and gauge identification numbers.

H. Submit copies of actual field records to Engineer/Architect promptly upon completion of each member or slab tensioning run.

I. Installer certify that stressing process and records have been reviewed, and that forces specified have been provided.

J. If it appears that design post-tensioning stresses are not being attained, re-check may be ordered by Engineer/Architect.

K. Do not cut or cover tendon ends until Contractor receives Engineer/Architect's written review of post-tensioning records.

L. Inspection agency to submit written reports as required in Section 1704.1.2 of California Building Code within 72 hours of inspection.

M. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

N. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.8 REFERENCES

A. Contractor: Keep a copy of PTI “Field Procedures Manual for Unbonded Single Strand Tendons” on site.

B. American Concrete Institute (ACI):

1. ACI 301, "Standard Specifications for Structural Concrete."
2. ACI 318, "Building Code Requirements for Structural Concrete."
3. ACI 347, "Recommended Practice for Concrete Formwork."
4. ACI 362.1R-97, “Guide for the Design of Durable Parking Structures.”
5. ACI 423.3R, "Recommendations for Concrete Members Prestressed with Unbonded Tendons."

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

1. ASTM A416, "Specification for Uncoated Seven-Wire Stress-Relieved Strand for Prestressed Concrete," including supplement, "Low Relaxation Strand."
2. ASTM E328, "Recommended Practice for Stress-Relaxation Tests for Materials and Structures."

D. Concrete Reinforcing Steel Institute (CRSI):

1. CRSI MSP-2, "Manual of Standard Practice."

E. Post-Tensioning Institute (PTI):

1. PTI, "Guide Specifications for Post-Tensioning Materials."
2. PTI, "Performance Specification for Corrosion Preventive Coating."
3. PTI, "Specification for Unbonded Single Strand Tendons."
4. PTI, "Field Procedures Manual for Unbonded Single Strand Tendons."

F. California Building Code CBC 2010:

1.9 DELIVERY, STORAGE AND HANDLING

A. Supplier: Assign all post-tensioning tendons within every group or in same member heat number and tag accordingly. Show modulus of elasticity for that heat on tag.

B. Supplier: Package each tendon bundle at source to prevent physical damage to tendon during transportation and storage and to positively protect strand from moisture and corrosion during transit and storage. Use heavy padding such as carpeting to protect sheathing and tendon from physical damage during transportation and storage and from being cut by binding materials. Use filament tape, not wire binding. Cardboard unacceptable. No part of any tendon shall ever be unprotected against moisture. Corrosion inhibitor coated bare strand unacceptable. Tendon damage during shipping shall be fabricator responsibility. Tendon damage during storage shall be general contractor responsibility.

C. Contractor/Installer: Inspect all tendons before unloading. Store properly.

D. Supplier: Remove and replace at no cost to Owner tendons with wires or strands which are broken or show severe fabrication defects.

E. Plastic on stressing tail to be removed only on day of stressing. Use special cutting tool or approved equal to remove sheathing.

F. Contractor/Installer: Do not store material on slabs to be prestressed before final prestress of slabs is accomplished. At no time shall weight of stored material placed on slab area, after prestressing is completed and concrete has reached specified 28 day strength, exceed total design load of that slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of that slab area.

1.10 SEQUENCING

A. See Drawings for tensioning and designed construction sequence. No departure permitted from tensioning sequence without prior written acceptance from Engineer/Architect.

1.11 WARRANTY

A. Provide warranty similar to sample below.

B. Sample:

1. Supplier warrants that all materials furnished have been manufactured in accordance with the specifications for this project. Supplier further warrants that if installation of said material is to be performed by those subject to its control and direction, work will be completed in accordance with the same specifications.
2. The period of this warranty shall be 5 years beginning at the date of Beneficial Occupancy. Should any defect develop during the contract warranty period, which can be directly attributed to defect in quality of product or workmanship, supplier shall, upon written notice, correct defects or replace products without expense to owner and/or contractor.

1.12 REPAIR WARRANTY

A. Furnish Owner with written total responsibility guarantee that repairs will be free of defects, water penetration and deterioration related to repair design, workmanship or material deficiency.

B. Warranty period shall be 5 years commencing with date of acceptance of repair.

C. Perform any repair under this warranty at no cost to Owner.

D. Before construction, provide Engineer/Architect with sample of final warranty. Guarantee shall be provided by installer.

PART 2 - PRODUCTS

2.1 POST-TENSIONING MATERIALS

A. Post-tensioning tendons, ASTM A416: Seven-wire, uncoated low relaxation steel strand, Grade 270 with minimum ultimate strength of 270,000 psi, unbonded system. All strand shall be manufactured by single source. If manufactured outside United States of America, strand shall be subject to Engineer/Architect's acceptance. Acceptance will be based on Engineer/Architect's review of evidence of satisfactory performance of strand in United States of America over past 5 years.

1. Provide in Bid 2 additional tons of placed post-tensioning tendons including anchors and accessories for inclusion in Project as Engineer directs. Return cost of unused portion to Owner at unit price stated on Bid Form. Submit to Engineer breakdown of use each month.

B. Sheathing: Make tendon sheathing for unbonded single strand tendons of material with following properties:

1. Sufficient strength to withstand unrepairable damage during fabrication, transport, installation, concrete placement and tensioning.
2. Water tightness over entire sheathing length.
3. Chemical stability, without embrittlement or softening over anticipated exposure temperature range and service life of structure.
4. Non-reactive with concrete, steel, and tendon corrosion preventive coating.
5. Color shall contrast with black corrosion preventive coating so that sheathing tears will be readily visible. Black/dark colored sheathing is unacceptable.
6. Sheathing: seamless and extruded high density polypropylene or seamless and extruded high density polyethylene. Density $\geq$ 0.95.
7. Sheathing thickness: min. 50 mil thickness –0 +15 mils
8. Inside diameter: at least 0.010 in. greater than maximum diameter of strand.
9. Make all connections and components watertight.

C. Tape:

1. “3M Tape No. 226,” 3M, St. Paul, MN.
2. “Patch #145 Vinyl – Rubber Adhesive,” 3M, St. Paul, MN.
3. “Polyken, Type 826,” Kendall Co., Boston, MA.
4. “PWT-20, Alltape,” Hialeah, FL.
5. Approved product similar in design, construction, and performance.

D. Repair Material for Sheathing

1. For nicks or cuts less 0.25 in. long: “Scotch-Weld DP-8005,” by 3M.
2. Approved product similar in design, construction, and performance.

E. Tendon corrosion inhibiting coating: Lithium-based, containing corrosion inhibitors, wetting agents, and less than 50 parts per million of chlorides, sulfides or nitrates:

1. Acceptable corrosion inhibiting coatings:

   a. "Shell PT Grease," Shell Oil Company, West Orange, NJ.
   b. "Visconorust PT 1001," Viscosity Oil, Willowbrook, IL.
   c. "Mobil Greasrex K218," Mobil Oil Company, Houston, TX.
   d. "Unocal PT1 Cable Grease," Unocal Corporation, Schaumburg, IL.
   e. “Century PT,” Fuchs Lubricants Company, Marion, IL.
   f. “Royal PT-1 & PT-2 Corrosion Inhibiting Grease,” Troco Oil Company, Tulsa, OK.
   g. Approved product similar in design, construction, and performance.

2. Corrosion inhibiting coating shall completely fill void between tendon and sheathing.

3. Minimum weight of corrosion inhibiting coating on tendon strand shall conform to ACI 423.6 requirements.
4. Corrosion inhibiting coating shall meet all requirements of PTI "Performance Specification for Corrosion Preventive Coating."

F. Couplings: In accordance with ACI 301 “Prestressed Concrete”, heading “Couplings” where indicated on Drawings or specified by Engineer/Architect. Completely fill coupler enclosure with corrosion inhibiting coating.

G. Anchorages: In accordance with ACI 301 Section “Prestressed Concrete”, heading “Anchorages for unbonded tendons”: design slab and beam anchors for transfer at 3,000 psi concrete strength; size bearing plates in accordance with ACI 301 unless certified test reports are submitted proving acceptable deviation. Anchorage system shall meet all requirements below and those of PTI Guide Specifications for non corrosive environment. All anchorage systems shall be accepted at least 14 days before Bid date.

H. Tendon anchorages and couplings shall be designed to develop strand strength specified in ASTM A416. Castings shall be nonporous and free of sand, blow holes, voids, and other defects. Bearing side of anchor casting shall have provision for plastic sleeve which shall prevent moisture leaks into anchor casting or tendon sheathing. For wedge type anchorages, wedge grippers shall be designed to preclude premature failure of prestressing steel due to notch or pinching effects under static and dynamic test load conditions stipulated under paragraph (a), for low relaxation prestressing steel materials.

I. Tendon anchor plates and wedges shall be same as those which passed static and dynamic test in accordance with Part 1 heading “Quality Control.”

J. Stressing pockets & anchorage recesses: Use plastic pocket former at stressing end to provide 2 in. minimum recess to anchor casting and 3 in. minimum width to allow access to cut off excess strand. At intermediate stressing ends, use grommet to prevent moisture leaks into anchor casting or tendon sheathing.

K. Anchorage Sheathing: At all anchorages, exposed prestressing steel shall be protected with corrosion inhibiting coating covered with plastic sheathing and adequately taped along its length. Sheathing must extend to anchorage. Bare strand is not acceptable.

L. Nails for attaching anchor assemblies to forms:

1. Stainless steel ring nails, Clendenin Bros., Baltimore, MD, or equal as acceptable to Engineer/Architect or use spindle type pocket formers.

M. Design Forces and Stresses:

1. Effective post-tensioning forces, after all losses have occurred, are shown on Drawings.
2. Maximum tensile stress in post-tensioning tendons due to jacking forces shall not exceed 80% of specified tensile strength or 94% of specified yield strength of

post-tensioning tendon, whichever is smaller, but not greater than maximum value recommended by manufacturer of post-tensioning tendons.

3. Maximum tensile stress in post-tensioning tendons immediately after anchorage shall not exceed 70% of specified tensile strength.
4. Slip of strand at anchorage shall not exceed 0.25 in. Measured elongation shall be within ± 7% of calculated.

2.2 ACCESSORIES

A. Tendon supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening tendons in place. Manufacture tendon supports according to CRSI's "Manual of Standard Practice" from all plastic of greater compressive strength than concrete, and as follows:

1. In manner acceptable to Engineer solely, tendon supports shall be color-coded to visually differentiate supports by height and shall be fabricated to resist overturning during construction operations.
2. For concrete surfaces exposed to view where tendon supports contact forms, supports shall have minimal contact, shall not cause voids and shall not cause damage to surrounding concrete. Use all-plastic supports conforming to CRSI Class 1 protection requirements.
3. Chairs shall be sized and spaced to prevent cover loss during construction operations.
4. Acceptable manufacturers:

    a. Aztec Concrete Accessories, Inc.
    b. General Technologies, Inc.
    c. Approved product similar in design, construction, and performance.

2.3 GROUT MATERIALS

A. Nonmetallic Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water reducing agents, complying with ASTM C 1107, Grade B, with fluid consistency and a 30-minute working time.

B. Products: Subject to compliance with requirements, provide one of the following:

1. Nonmetallic Shrinkage-Resistant Grout:

    a. Sure Grip Grout, Dayton Superior.
    b. Euco N.S., Euclid Chemical Co.
    c. Masterflow 928, Master Builders, Inc.
    d. Approved product similar in design, construction, and performance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Furnish necessary information, materials, accessories and other items for prestressing and attaining effective post-tensioning forces, after all losses have occurred, as shown on Drawings and specified in this Section.

B. Maintain post-tensioning equipment in safe, working condition.

C. Satisfactorily protect post-tensioning tendons from rust or other corrosion before placement. No exposed strand is permitted at any time during shipping or casting. Cut ends shall receive a protective cap in order to prevent water from being drawn into tendon by means of capillary action. Any stripped sheathing on the stressing tail has to be replaced.

3.2 INSTALLATION

A. Placement:

1. Place tendons with parabolic profile in vertical plane conforming to control points shown on Drawings unless otherwise specified:

    a. Dimensions locating profile are given to center of gravity of tendons.
    b. Low points are at midspan unless noted otherwise. Provide positive support at tendon low points.
    c. Where tendons interfere with one another, contact Engineer/Architect before relocating tendons.
    d. Support slab tendons independently of beam reinforcement.

2. Space tendons evenly within slab to achieve required effective prestress as shown on Drawings:

    a. Slight deviations in spacing are permitted to avoid specifically located openings and inserts.
    b. Maximum main slab tendon spacing per CBC.
    c. Prohibited: Bundling of more than two slab tendons without prior written permission from Engineer/Architect.

3. Straighten strands to produce equal stress in all tendons that are to be stressed simultaneously and to insure proper positioning of anchors.
4. Run tendons parallel to grid lines unless otherwise noted.
5. Run tendons full length within pour without splices or couplers.
6. Install horizontal and vertical spacers or chairs to hold tendons in required position and to conform to specified profile.
7. Space tendon support chairs at 48 in. maximum.
8. Tendons and anchorages shall be supported firmly to prevent displacement during subsequent operations.

9. Place tendons and anchorages to both horizontal and vertical tolerances for corresponding horizontal and vertical member dimensions:

    a. 8 in. and less: ± 0.125 in.
    b. 8 to 24 in.: ± 0.375 in.
    c. Greater than 24 in.: ± 0.5 in.
    d. Deviations in horizontal plane which may be necessary to avoid openings or inserts shall have radius of curvature ≥ 21 ft.

10. Over occupied/finished areas, permanently mark tendon locations on slab soffit.
11. Stressing anchorages shall be installed perpendicular to tendon axis. Curvature in tendon profile shall not be closer than 3 ft from stressing anchorage.
12. Stressing anchorages shall be rigidly attached to bulkhead forms. Connections shall be sufficiently rigid to avoid accidental loosening due to construction activity or during concrete placement.
13. Pocket formers at stressing and intermediate stressing anchorages shall positively preclude intrusion of concrete or cement slurry into wedge cavity during concrete placement. Depth of pocket former from exterior edge of concrete to closest surface of wedge cavity area of anchor shall not be less than **2 in.**
14. Satisfactorily protect post-tensioning tendons from moisture, rust or other corrosion prior to placement of concrete. Provide protection for exposed prestressing steel at ends of members and at intermediate anchorages to prevent water from getting on or into tendons and sheathing at all times during construction.

B. Sheathing Inspection and Repair:

1. After installing tendons in forms and before concrete casting, sheathing shall be inspected for possible damage.
2. Damaged areas shall be repaired by restoring corrosion preventive coating in damaged area, and repairing sheathing to satisfaction of Engineer/Architect.
3. Sheathing repair procedure:

    a. Restore tendon corrosion preventive coating in damaged area.
    b. Coat with corrosion preventive coating outside of sheathing length of damaged area, plus 2 in. beyond each end of damage. Example: If sheathing tear is 6 in. long, then corrosion preventive coated area will be 10 in. long, centered on tear.
    c. Place piece of longitudinally slit sheathing around corrosion preventive coated tendon. Slit shall be on side of tendon opposite tear. Length of slit sheathing shall overlap corrosion preventive coated area by 2 in. at each end. Example: If corrosion preventive coated area is 10 in. long, then sheathing will be 14 in. long, centered on tear.
    d. Tape entire length of slit sheathing, spirally wrapping tape around sheathing to provide at least 2 layers of tape. Taping shall overlap slit sheathing by 2 in. at each end. Before taping, sheathing shall be dry and free of corrosion preventive coating. Example: If slit sheathing is 14 in. long, then taped area will be 18 in. long, centered on tear.
    e. Repair material specified in Part 2 may be used to repair nicks or cuts less than 0.25 in. long.

4. Any damage to shop assembled tendon encapsulating system, such as sheathing tears or cuts (beyond that specified as repairable), sheathing withdrawn from connecting sleeves, or connecting sleeves withdrawn from dead end anchorages shall be cause for rejection by Contractor or Engineer/Architect.

C. Tensioning:

1. Take safety precautions to prevent workers from standing behind or above jacks during tensioning.
2. It is imperative that P/T beams and slabs reach 3,000 psi compressive strength in 96 hours or less. Tensioning should commence as soon as concrete strength reaches 3,000 psi. Tensioning must be complete within 96 hours of commencement of placement, unless strength has not reached 3,000 psi. If within 96 hours (including Saturdays, Sundays and holidays) after concrete placement commenced, strength has not reached this limit, apply one-half stress to each wire or strand and full stress applied when concrete compressive strength reaches 3,000 psi. No exceptions to this requirement permitted.
3. Stress all post-tensioning tendons by means of hydraulic jacks, equipped with accurate reading, calibrated hydraulic pressure gauges to permit stress in post-tensioning steel to be computed at any time:

    a. Provide certified calibration curve with each jack.
    b. If deviation greater than 7% occurs between measured elongation and computed elongation for given jack gauge pressure, recalculate elongations based on actual material properties.
    c. If, after jack calibration and modulus check, computed and measured elongation for given gauge pressure still deviate by more than 7%, cease tensioning operations. Review section 7.3 from “Field Procedures Manual for Unbonded Single Strand Tendons” for causes for improper elongation of tendons. Resolve deviation to satisfaction of Engineer/Architect. Do not proceed with stressing until the cause of the deviation is found and corrected.

D. Cutting Tendons After Stressing:

1. Do not cut tendons or cover pockets until elongation records are reviewed and accepted by Engineer/Architect.
2. Clean tendons, anchorages and pockets of corrosion preventive coating with non-corrosive solvent before removal of excess length of post-tensioning tendons.
3. Sever each tendon using a ‘cold-cut’ shear device.

    a. Sever tendon within the pocket, allowing for no less than 0.75 in. of concrete cover over the end of each tendon. Leave all tendon ends clean and free of burrs. All tendon ends shall be accessible for inspection prior to and during severing, protective end cap placement and/or grout. Do not use oxyacetylene torches to sever tendons unless Engineer accepts in writing before cutting.

4. Do not damage tendon, anchorage or concrete during removal of excess length of tendon.

3.3 FIELD QUALITY CONTROL

A. Contractor: Inspect tendons after installation. Reject, repair or replace nonconforming work.

B. Tendon sheathing damaged over more than 10% of length shall be rejected. Damaged length need not be continuous.

C. Before concrete placement around sheathing, all tendon damage shall be repaired to watertight condition. Repairs shall be acceptable to Engineer/Architect.

D. Inspect sheathing for unrepaired damage, for watertight seal between sheathing and anchor, and for correct installation of anchors, before concrete is placed around tendons. Sheathing must extend tight to anchorage and be continuous.

E. Wedges shall be flush with anchor casting or protrude not more than 0.125 inch.

3.4 PROTECTION

A. After removing excess length of tendon and before grouting tendon pocket, coat pocket surfaces with bonding agent.

B. Grout tendon pockets solid with non-shrink, non-stain, chloride free grout as specified in this Section.

3.5 EXTRA STOCK

A. Maintain on site adequate supplies of repair tape and tendon corrosion preventive coating to make repairs.

B. Maintain spare jack on site during post-tensioning operations.

3.6 REPAIRS

A. General Contractor: Responsible for all repairs.

B. Post-tensioning Contractor: Submit repair procedures to Engineer/Architect for evaluation and acceptance.

END OF SECTION 03 38 17

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SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Ties and anchors.
5. Miscellaneous masonry accessories.

1.3 DEFINITIONS

A. CMU(s): Concrete masonry unit(s).

1.4 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
5. Prism Test: For each type of construction required, according to ASTM C 1314.

1.5 SUBMITTALS

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

B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection:

1. Decorative CMUs, in the form of small-scale units.
2. Pre-faced CMUs.
3. Colored mortar.
4. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. Exposed Decorative CMUs.
2. Pre-faced CMUs.
3. Accessories embedded in masonry.

E. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers' product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

F. Qualification Data: For testing agency.

G. Material Certificates: For each type and size of the following:

1. Masonry units.

    a. Include material test reports substantiating compliance with requirements.
    b. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
6. Joint reinforcement.
7. Anchors, ties, and metal accessories.

H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

I. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

J. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

D. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide square-edged units for outside corners unless otherwise indicated.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 1500 psi.
2. Density Classification: Medium weight.
3. Size (Width): As indicated on Drawings. Manufactured to dimensions 3/8 inch less than nominal dimensions.
4. Retain first subparagraph below if color and texture of faces are critical. ASTM C 90 requires at least four units for sample, representing the range of color and texture permitted.
5. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.
6. Faces to Receive Plaster: Where units are indicated to receive a direct application of plaster, provide textured-face units made with gap-graded aggregates.

2.3 CONCRETE LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs**.**

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Division 03 Section "Cast-in-Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

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

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Masonry Cement: ASTM C 91.

E. Mortar Cement: ASTM C 1329.

F. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979. Use only pigments with a record of satisfactory performance in masonry mortar.

G. Aggregate for Mortar: ASTM C 144.

1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

H. Aggregate for Grout: ASTM C 404.

I. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

J. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.

2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
4. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
6. Stainless-Steel Sheet: ASTM A 666,Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
8. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

2.7 MISCELLANEOUS ANCHORS

A. Unit Type Inserts in Concrete: Cast-iron or malleable-iron wedge-type inserts.

B. Dovetail Slots in Concrete: Furnish dovetail slots with filler strips, of slot size indicated, fabricated from 0.034-inch, galvanized steel sheet.

C. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene urethane or PVC.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

2.9 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
1. Mortar for Unit Masonry: Comply with ASTM C 270, Mortar shall be Type S or Type.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Proportion grout in accordance with ASTM C 476,paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).

3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Allow cleaned surfaces to dry before setting.
3. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

E. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 LINTELS

A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.

B. Inspections: Provide special inspections according to the "California Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 28 days.

3.7 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

END OF SECTION 04 22 00

SECTION 05 16 17 - STRAND GUARDRAIL SYSTEM

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 metal fabrications:

1. Strand guardrail.

1.3 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Shop drawings detailing fabrication and erection of each fabrication. Include plans, elevations, sections, and details of fabrications and their connections. Show anchorage and accessory items. Provide templates for anchors and bolts.

C. Samples representative of materials and finished products as may be requested by Engineer/Architect.

D. Qualification data for firms and persons specified in the "Quality Assurance" article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of architects and owners, and other information specified.

E. See requirements of Division 01 Section, “Submittal Procedures,” for limits to resubmittals.

F. See requirements of Division 01 Section, “Submittal Procedures,” for RFI constraints.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing guardrail strand fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

1.5 REFERENCES

A. American Institute of Steel Construction (AISC):

1. AISC, "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC, "Manual of Steel Construction."
3. AISC, "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings."

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

1. ASTM A36, "Specification for Structural Steel."
2. ASTM A123, "Specification for Zinc (Hot-Dip Galvanized) Coatings On Iron and Steel Products."
3. ASTM A164, "Specification for Electrodeposited Coatings of Zinc on Steel."
4. ASTM A386, "Specification for Zinc Coating (Hot-Dip) on Assembled Steel Products."
5. ASTM A416, "Specification for Steel Strand, Uncoated Seven-Wire Stress-Relieved, for Prestressed Concrete."
6. ASTM A475, "Specification for Zinc-Coated Steel Wire Strand."
7. ASTM A882, "Standard Specification for Epoxy-Coated Seven-Wire Prestressing Steel Strand."
8. ASTM B454, "Specification for Mechanically Deposited Coatings of Cadmium and Zinc on Ferrous Metals."

C. Post-Tensioning Institute

1. “Specification for Seven Wire Strand Barrier Cable Applications.”

1.6 PROJECT CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which strand guardrails must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 FERROUS METALS

A. General: Comply with Post-Tensioning Institute’s “Specification for Seven Wire Steel Strand Barrier Cable Applications.”

B. Vehicular Guardrail Strand and Terminal Fittings: 7 wire, steel wire strand, ASTM A 475, Common Grade, Class A zinc coating, 0.375 in. diameter. Terminal fittings to be:

1. Swaged and threaded stubs with washers and nuts as shown on Drawings, stainless steel, ASTM A 320, Grade B8F, AISI Type 303 Se, and:
2. Similar to threaded stud No. MS 21259-12, Loos and Company, Inc., Pomfret, Connecticut.

C. Guardrail Strand and Prestressing/Post-Tensioning Anchors:

1. Seven wire, steel strand, 0.375 in. diameter, galvanized stress-relieved prestressing strand, with minimum ultimate tensile strength of 250,000 psi.
2. Strand to have continuous hot-dip galvanized coating. Minimum weight of zinc coating shall be 0.90 oz./sq. ft.(Class A).
3. Anchor bodies shall be galvanized and compatible with strand system furnished. Anchor bodies shall comply with Post-Tensioning Institute “Specification for Unbonded Single Strand Tendons.” Environment: corrosive. Repair damaged metal surfaces by cleaning and applying two coats of galvanizing repair paint to galvanized surfaces. Apply two coats of galvanizing repair paint to wedge grippers after stressing is complete.
4. Anchor back seating force. Unless noted otherwise, back seat all anchors to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.

D. Guardrail Strand and Terminal Fittings:

1. Seven wire, steel strand, 0.375 in. diameter, ASTM A416, with minimum ultimate tensile strength of 270,000 psi.
2. Anchor bodies shall be galvanized and compatible with strand system furnished. Anchor bodies shall comply with Post-Tensioning Institute “Specification for Unbonded Single Strand Tendons.” Environment: corrosive. Repair damaged metal surfaces by cleaning and applying two coats of galvanizing repair paint to galvanized surfaces. Apply two coats of galvanizing repair paint to wedge grippers after stressing is complete.
3. Anchor back seating force. Unless noted otherwise, back seat all anchors to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.

2.2 FABRICATION, GENERAL

A. Form strand guardrail from materials of size, thickness, and shapes indicated but not less than that needed to comply with performance requirements indicated. Work to dimensions indicated or accepted on shop drawings, using proven details of fabrication and support. Use type of materials indicated or specified for various components of each metal fabrication.

B. Allow for thermal movement resulting from the following maximum change (range) in ambient temperature in the design, fabrication, and installation of installed strand guardrail assemblies to prevent over stressing. Base design calculations on actual surface temperatures of metals due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 100 F°.

C. Provide for anchorage of type indicated; coordinate with supporting structure. Fabricate and space anchoring devices to secure strand guardrails rigidly in place and to support indicated loads.

D. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

E. Fabricate joints that will be exposed to weather in a manner to exclude water.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions, and directions for installing anchorages. Coordinate delivery of such items to Project site.

3.2 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchor bodies where necessary for securing miscellaneous metal fabrications to in-place construction.

B. If the guardrail strands are required to be post-tensioned:

1. Backstress all fixed and stressing anchorages.
2. Backstress after the guardrail strand has been stressed.
3. Backstress the guardrail strand to a force equal to 80% of the minimum ultimate tensile strength (MUTS) of the strand.
4. Prevent damage to the column or other member to which the guardrail strand is anchored.
5. For related procedures refer to the PTI Guide Specification.

3.3 ADJUSTING AND CLEANING

A. For galvanized surfaces, clean welds, bolted connections, and abraded areas, and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION 05 16 17

SECTION 05 30 00 - STEEL DECKING

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. Steel roof deck.
2. Composite steel floor deck.
3. Noncomposite steel form deck.

B. Related Sections: Following Sections contain requirements that relate to this Section:

1. Division 03 Section "Cast-in-Place Concrete" for concrete fill and reinforcing steel.
2. Division 05 Section "Structural Steel" for shop-welded shear connectors.
3. Division 05 Section "Metal Fabrications" for framing openings with miscellaneous steel shapes.

C. Openings in deck shall be provided by contractor needing the opening.

1.3 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 each type of deck, accessory, and product specified.

C. Shop drawings showing layout and types of deck panels, anchorage details, reinforcing channels, pans, deck openings, special jointing, accessories, and attachments to other construction.

1. For steel deck indicated to comply with certain design loadings, include structural analysis data sealed and signed by the qualified professional Engineer/Architect who was responsible for its preparation.

D. Product certificates signed by manufacturers of steel deck certifying that their products comply with specified requirements.

E. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" article.

F. Product test reports from qualified independent testing agencies evidencing compliance with requirements of the following based on comprehensive testing:

1. Mechanical fasteners.

G. Research reports or evaluation reports of the model code organization acceptable to authorities having jurisdiction that evidence steel deck's compliance with the building code in effect for the Project.

H. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

I. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed steel deck similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Testing Agency Qualifications: To qualify for acceptance, an independent testing agency must demonstrate to Engineer/Architect's satisfaction, based on evaluation of agency-submitted criteria conforming to ASTM E 699, that it has the experience and capability to satisfactorily conduct the testing indicated without delaying the Work.

C. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code--Steel" and AWS D1.3 "Structural Welding Code--Sheet Steel."

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

D. Fire-Test-Response Characteristics: Where indicated, provide steel deck panels identical to those tested as part of an assembly for fire resistance per ASTM E 119 by a testing and inspection agency performing testing and follow-up services, that is acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: As indicated by design designations listed in UL "Fire Resistance Directory," or by Warnock Hersey or another testing and inspecting agency.
2. Labeling: Identify steel deck with appropriate markings of applicable testing and inspecting agency.

E. Engineer Qualifications: Professional engineer legally authorized to practice in **State** and experienced in providing engineering services of the kind indicated that have resulted in installation of steel deck similar to this Project in material, design, and extent and that have a record of successful in-service performance.

1.5 REFERENCES

A. American Institute of Steel Construction (AISC):

1. AISC, "Code of Standard Practice for Steel Buildings and Bridges."
2. AISC, "Manual of Steel Construction."
3. AISC, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings."

B. American Iron and Steel Institute (AISI):

1. AISI, "Specification for the Design of Cold-Formed Steel Structural Members."

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

1. ASTM A36, "Specification for Structural Steel."
2. ASTM A653, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality."
3. ASTM A525, "Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process."
4. ASTM A653, "Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Commercial Quality."
5. ASTM A611, "Specification for Steel Sheet, Carbon, Cold-Rolled, Structural Quality."

D. American Welding Society (AWS):

1. AWS D1.1, "Structural Welding Code-Steel."

E. National Association of Architectural Metal Manufacturers (NAAMM):

1. NAAMM, "Metal Stair Manual."

F. Steel Deck Institute (SDI):

1. SDI Pub. #27, "Design Manual for Composite Decks, Form Decks, Roof Decks, and Cellular Metal Floor Deck with Electrical Distribution."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Buildings Co.
2. ASC Pacific Inc.
3. Bowman Metal Deck Armco, Inc.
4. Consolidated Systems, Inc.
5. Epic Metals Corp.
6. Marlyn Steel Products, Inc.
7. Robertson A United Dominion Co.
8. Roof Deck, Inc.
9. United Steel Deck, Inc.
10. Verco Manufacturing Co.
11. Vulcraft Div. of Nucor Corp.
12. Walker Div. of Butler Manufacturing Co.
13. Wheeling Corrugating Co., Div. of Wheeling-Pittsburgh Steel Corp.

2.2 ROOF DECK

A. Steel Roof Deck: Fabricate panels without top-flange stiffening grooves conforming to SDI Publication No. 28 "Specifications and Commentary for Steel Roof Deck" and the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Grade A, G 60 zinc coated according to ASTM A 525; cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free rust-inhibitive primer.
2. Profile Depth: 1.5 in. (38 mm).
3. Design Uncoated-Steel Thickness: 0.0474 in. (1.20 mm).
4. Span Condition: As indicated.
5. Side Joints: Overlapped or interlocking seam at Contractor's option.

2.3 FLOOR DECK

A. Composite Steel Floor Deck: Fabricate panels with integrally embossed or raised pattern ribs and interlocking side laps, conforming to SDI Publication No. 28 "Specifications and Commentary for Composite Steel Floor Deck," the minimum section properties indicated, and the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Grade A, G 60 zinc coated according to ASTM A 525; cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free rust-inhibitive primer.
2. Profile Depth: 1.5 in. (38 mm).
3. Design Uncoated-Steel Thickness: 0.0474 in. (1.20 mm).
4. Span Condition: As indicated.

2.4 FORM DECK

A. Noncomposite Steel Form Deck: Fabricate ribbed-steel sheet noncomposite form deck panels conforming to SDI Publication No. 28 "Specifications and Commentary for Noncomposite Steel Form Deck," the minimum section properties indicated, and the following:

1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653, Grade E, G 60 zinc coated according to ASTM A 525; cleaned, pretreated, and primed with manufacturer's baked-on, lead- and chromate-free rust-inhibitive primer.
2. Profile Depth: 1.5 in. (38 mm).
3. Design Uncoated-Steel Thickness: 0.0474 in. (1.20 mm).
4. Span Condition: As indicated.
5. Side Joints: Overlapped or interlocking seam at Contractor's option.

2.5 ACCESSORIES

A. General: Provide accessory materials for steel deck that comply with requirements indicated and recommendations of the steel deck manufacturer.

B. Mechanical Fasteners: Manufacturer's standard, corrosion-resistant, low-velocity, powder-actuated or pneumatically driven carbon steel fasteners; or self-drilling, self-threading screws.

C. Side Lap Fasteners: Manufacturer's standard, corrosion-resistant, hexagonal washer head; self-drilling, carbon steel screws, No. 10 (4.8 mm) minimum diameter.

D. Rib Closure Strips: Manufacturer's standard vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Roof Deck Accessories: Steel sheet, 0.0359-in.- (0.91-mm-) thick minimum ridge and valley plates, finish strips, and reinforcing channels, of same material as roof deck.

F. Pour Stops and Girder Fillers: Steel sheet, of same material as deck panels, and of thickness and profile indicated.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material and thickness as deck panels, unless otherwise indicated.

H. Hanger Tabs: Manufacturer's standard piercing steel sheet hanger attachment devices for floor deck panels.

I. Weld Washers: Manufacturer's standard uncoated-steel sheet weld washers, shaped to fit deck rib, 0.0598 in. thick with 0.375-in. minimum diameter prepunched hole.

J. Recessed Sump Pans: Manufacturer's standard size, single piece steel sheet 0.071-in.- thick minimum, of same material as deck panels, with 1.5-in.- minimum deep level recessed pans and 3-in.- wide flanges. Cut holes for drains in the field.

K. Flat Receiver Pan: Manufacturer's standard size, single-piece steel sheet, 0.071-in.- thick minimum units, of same material as deck panels. Cut holes for drains in the field.

L. Shear Connectors: ASTM A 108, Grade 1010 through 1020 headed stud type, cold-finished carbon steel, AWS D1.1, Type B.

M. Steel Sheet Accessories: ASTM A 653, G 60 coating class, galvanized according to ASTM A 525.

N. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035, with dry film containing a minimum of 94% zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.2 PREPARATION

A. Do not place deck panels on concrete supporting structure until concrete has cured and is dry.

B. Locate decking bundles to prevent overloading of supporting members.

3.3 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary of SDI Publication No. 28, manufacturer's recommendations, and requirements of this Section.

B. Install temporary shoring before placing deck panels when required to meet deflection limitations.

C. Place deck panels on supporting framing and adjust to final position with ends accurately aligned and bearing on supporting framing before being permanently fastened. Do not stretch or contract side lap interlocks.

D. Place deck panels flat and square and fasten to supporting framing without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to the decking.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of decking, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's instructions.

3.4 ROOF DECK INSTALLATION

A. Fasten roof deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter, but not less than 1.5 in. (38 mm) long, and as follows:

1. Weld Diameter: 0.75 in., nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space welds an average of **12** in. apart, with a minimum of two welds per unit at each support.

B. Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding **36** in., using one of the following methods:

1. Mechanically fasten with self-drilling No. 10- diameter or larger carbon steel screws.
2. Fasten with 1.5-in.- long minimum welds.

C. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1.5 in., with end joints as follows:

1. End Joints: Lapped 2 in. minimum.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof decking, and weld flanges to top of deck. Space welds not more than 12 in. apart with at least one weld at each corner.

E. Miscellaneous Roof Deck Accessories: Install ridge and valley plates, finish strips, cover plates, end closures, and reinforcing channels according to deck manufacturer's recommendations. Weld to substrate to provide a complete deck installation.

F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's instructions to ensure complete closure.

3.5 FLOOR DECK INSTALLATION

A. Fasten floor deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 0.75 in. (19 mm), nominal.
2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of **12** in. apart, but not more than 18 in. apart.

B. Side Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, or at intervals not exceeding **36** in., using one of the following methods:

1. Mechanically fasten with self-drilling No. 10- diameter or larger carbon steel screws.
2. Fasten with 1.5-in.- long minimum welds.

C. End Bearing: Install deck ends over supporting framing with a minimum end bearing of 1.5 in., with end joints as follows:

1. End Joints: Lapped.
2. Shear Connectors: Weld shear connectors through deck to support framing according to AWS D1.1 and manufacturer's instructions. Butt end joints of deck panels; do not overlap.
3. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations, unless otherwise indicated.

D. Floor Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck according to SDI recommendations to provide tight-fitting closures at open ends of ribs and sides of decking. Weld cover plates at changes in direction of floor deck panels, unless otherwise indicated.

E. Install piercing hanger tabs not more than **14** in. apart in both directions, within **9** in. of walls at ends, and not more than **12** in. from walls at sides, unless otherwise indicated.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Qualified independent testing agency employed and paid by Owner will perform field quality-control testing.

B. Field welds will be subject to inspection.

C. Shear connector welds will be inspected and tested according to the requirements of AWS D1.1 for stud welding and as follows:

1. Shear connector welds will be visually inspected.
2. Bend tests will be performed when visual inspections reveal either less than a continuous 360° flash or welding repairs to any shear connector.
3. Tests will be conducted on additional shear connectors when weld fracture occurs on shear connectors already tested, according to the requirements of AWS D1.1.

D. Testing agency will report test results promptly and in writing to Contractor and Engineer/Architect.

E. Remove and replace work that does not comply with specified requirements.

F. Additional testing will be performed to determine compliance of corrected work with specified requirements.

3.7 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces with galvanized repair paint according to ASTM A 780 and the manufacturer's instructions.

B. Touchup Painting: Wire brush, clean, and paint scarred areas, welds, and rust spots on both surfaces of installed deck panels.

1. Touch up painted surfaces with same type of shop paint used on adjacent surfaces.
2. Where shop-painted surfaces are exposed in-service, apply touchup paint to blend into adjacent surfaces.

C. Provide final protection and maintain conditions to ensure steel decking is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 30 00

SECTION 055000 - METAL FABRICATIONS

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. Steel framing and supports for mechanical and electrical equipment.
2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
3. Elevator machine beams, and hoist beams.
4. Support angles for elevator door sills.
5. Shelf angles.
6. Steel weld plates and angles for casting into concrete not specified in other Sections.
7. Metal ladders.
8. Metal bollards.
9. Pipe guards.

B. Related Sections include the following:

1. Division 03 Section "Concrete" for installing anchor bolts, steel pipe sleeves, wedge-type inserts and other items indicated to be cast into concrete.
2. Division 04 Section "Brick Veneer".
3. Division 05 Section "Structural Steel Framing."
4. Division 05 Section "Metal Stairs."
5. Division 05 Section "Pipe and Tube Railings."
6. Division 14 Section "Hydraulic Elevators" for support angles for elevator door sills.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance of Ladders: Provide ladders capable of withstanding the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

B. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of

components, failure of 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Nonslip aggregates and nonslip-aggregate surface finishes.
2. Metal nosings and treads.
3. Paint products.
4. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
2. Provide templates for anchors and bolts specified for installation under other Sections.
3. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type and finish of extruded nosing.

D. Welding certificates.

E. Qualification Data: For professional engineer.

1.5 QUALITY ASSURANCE

A. 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."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Provide allowance for trimming and fitting at site.

1.7 COORDINATION

A. Coordinate installation of anchorages for metal fabrications. 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.

B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METALS, GENERAL

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.

2.3 FERROUS METALS

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

B. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666, Type 304.

C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

D. Steel Tubing: ASTM A 500, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, standard weight, unless another weight is indicated or required by structural loads.

F. Cast Iron: ASTM A 48/A 48M, Class 30, unless another class is indicated or required by structural loads.

G. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25 (Grade 170), unless another grade is required by design loads; exposed.

H. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30 (Grade 205), unless another grade is required by design loads.

I. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating, either commercial steel, Type B, or structural steel, Grade 33 (Grade 230), unless another grade is required by design loads.

2.4 NONFERROUS METALS

A. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

D. Bronze Extrusions: ASTM B 455, Alloy UNS No. C38500 (extruded architectural bronze).

E. Bronze Castings: ASTM B 584, Alloy UNS No. C83600 (leaded red brass) or No. C84400 (leaded semired brass).

F. Nickel Silver Castings: ASTM B 584, Alloy UNS No. C97600 (20 percent leaded nickel bronze).

2.5 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Anchor Bolts: ASTM F 1554, Grade 36.

1. Provide hot-dip or mechanically deposited, zinc-coated anchor bolts where item being fastened is indicated to be galvanized.

D. Machine Screws: ASME B18.6.3 (ASME B18.6.7M).

E. Lag Bolts: ASME B18.2.1 (ASME B18.2.3.8M).

F. Plain Washers: Round, ASME B18.22.1 (ASME B18.22M).

G. Lock Washers: Helical, spring type, ASME B18.21.1 (ASME B18.21.2M).

H. Cast-in-Place Anchors in Concrete: Anchors capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, hot-dip galvanized per ASTM A 153/A 153M.

I. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Anchors in Exterior Locations: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M).

2.6 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Division 09 painting sections.

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content that meets SCAQMD.
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

D. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content that meets SCAQMD.
2. Products:

a. Benjamin Moore & Co.; Epoxy Zinc-Rich Primer CM18/19.
b. Carboline Company; Carbozinc 621.
c. ICI Devoe Coatings; Catha-Coat 313.
d. International Coatings Limited; Interzinc 315 Epoxy Zinc-Rich Primer.
e. PPG Architectural Finishes, Inc.; Aquapon Zinc-Rich Primer 97-670.
f. Sherwin-Williams Company (The); Corothane I GalvaPac Zinc Primer.

g. Tnemec Company, Inc.; Tneme-Zinc 90-97.
h. Approved product similar in design, construction, and performance.

E. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it

F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

G. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

H. Concrete Materials and Properties: Comply with requirements in Division 03 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa), unless otherwise indicated.

2.7 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. 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.

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

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply 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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.8 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Furnish inserts if units are installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches (200 mm), unless otherwise indicated.

C. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.10 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Prime shelf angles located in exterior walls with zinc-rich primer.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.11 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Prime plates with zinc-rich primer.

2.12 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.13 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.14 METAL LADDERS

A. General:

1. Comply with ANSI A14.3, unless otherwise indicated.
2. For elevator pit ladders, comply with ASME A17.1.

B. Steel Ladders:

1. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
2. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
3. Products:
   a. IKG Industries, a Harsco company; Mebac.
   b. W. S. Molnar Company; SlipNOT.
   c. Approved product similar in design, construction, and performance.
4. Prime interior ladders, including brackets and fasteners, with zinc-rich primer.

2.15 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Fabricate bollards with 3/8-inch- (9.5-mm-) thick steel baseplates for bolting to concrete slab. Drill baseplates at all 4 corners for 3/4-inch (19-mm) anchor bolts.

1. Where bollards are to be anchored to sloping concrete slabs, angle baseplates for plumb alignment of bollards.

2.16 PIPE GUARDS

A. Fabricate pipe guards from 3/8-inch- (9.5-mm-) thick by 12-inch- (300-mm-) wide steel plate, bent to fit flat against the wall or column at both ends and to fit around pipe with 2-inch (50-mm) clearance between pipe and pipe guard. Drill each end for two 3/4-inch (19-mm) anchor bolts.

B. Prime pipe guards after fabrication with zinc-rich primer.

2.17 STEEL AND IRON FINISHES

A. 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 metal fabrications:

1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

B. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint

Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

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. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with a heavy coat of bituminous paint.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to and rigidly brace from building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

3.3 INSTALLING PIPE BOLLARDS

A. Anchor bollards to existing construction with through bolts. Provide four 3/4-inch (19-mm) bolts at each bollard, unless otherwise indicated.

1. Embed anchor bolts at least 4 inches (100 mm) in concrete.

B. Anchor bollards in place with concrete footings. Center and align bollards in holes 3 inches (75 mm) above bottom of excavation. Place concrete and vibrate or tamp for consolidation. Support and brace bollards in position until concrete has cured.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING PIPE GUARDS

A. Provide pipe guards at exposed vertical pipes in parking garage where not protected by curbs or other barriers. Install by bolting to wall or column with expansion anchors. Provide four 3/4-inch (19-mm) bolts at each pipe guard. Mount pipe guards with top edge 26 inches (660 mm) above driving surface.

3.5 INSTALLING THRESHOLDS

A. Seal thresholds exposed to exterior with elastomeric sealant complying with Division 07 Section "Joint Sealants" to provide a watertight installation.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 9 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 10

SECTION 05 51 00 - METAL STAIRS

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. Section Includes:

1. Preassembled steel stairs with concrete-filled treads.
2. Railings attached to metal stairs.
3. Handrails attached to walls adjacent to metal stairs.

B. Related Sections:

1. Division 3 Section "Concrete" for concrete fill for stair treads and platforms.
2. Division 5 Section “Metal Fabrications” for stair support framing with miscellaneous steel shapes.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Uniform Load: 100 lb/sq. ft. (4.79 kN/sq. m).
2. Concentrated Load: 300 lb (1.33 kN) applied on an area of 4 sq. in. (2580 sq. mm).
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to [L/240] or 1/4 inch (6.4 mm), whichever is less.

C. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lb/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lb (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lb (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7

1. Component Importance Factor is 1.5.

1.4 SUBMITTALS

A. Product Data: For metal stairs and the following:

1. Pre-filled metal-pan stair treads.
2. Paint products.
3. Grout.

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

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Precast concrete treads.
2. Epoxy-resin-filled stair treads.
3. Stair treads with nonslip-aggregate surface finish.
4. Metal floor plate treads.
5. Grating treads.
6. Abrasive nosings.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer

G. Welding certificates.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.

1. Test railings according ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

1. Preassembled Stairs: [Commercial] class.
2. Industrial-Type Stairs: Industrial class.
3. Ornamental Stairs: Architectural class.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs. 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.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts,[railings,] clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.
2. Use connections that maintain structural value of joined pieces.
3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Preassembled Stairs: Assemble stairs in shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

C. 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.

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

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply 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. Weld exposed corners and seams continuously unless otherwise indicated.
5. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

H. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

2.3 STEEL-FRAMED STAIRS

A. 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]:

1. Alfab, Inc.
2. American Stair, Inc.
3. Sharon Companies Ltd. (The).

B. Stair Framing:

1. Fabricate stringers of steel plates or channels.

   a. Provide closures for exposed ends of channel stringers.

2. Construct platforms of steel plate or channel headers and miscellaneous framing members as [needed to comply with performance requirements]].
3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.
4. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal-Pan Stairs: Form risers, sub-tread pans, and sub-platforms to configurations shown from steel sheet of thickness needed to comply with performance requirements but not less than 0.067 inch (1.7 mm).

1. Steel Sheet: Uncoated hot rolled steel sheet.
2. Attach risers and sub-treads to stringers with brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting, or bolting.
3. Shape metal pans to include nosing integral with riser.
4. Attach abrasive nosings to risers.

2.4 STAIR RAILINGS

A. Steel Angle Railings: Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of angle, post spacings, and anchorage, but not less than that needed to withstand indicated loads.

1. Rails and Posts: as indicated on drawings
2. Picket Infill: as indicated on drawings
3. Infill: as indicated on drawings.

B. Welded Connections: Fabricate railings with welded connections. Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 2 welds: completely sanded joint, some undercutting and pinholes okay

C. Form changes in direction of railings as follows:

1. As detailed.
2. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated].

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

E. Close exposed ends of railing members with prefabricated end fittings.

F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

G. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnecting components and for attaching to other work. Furnish inserts and other anchorage devices for connecting to concrete or masonry work.

1. Connect posts to stair framing by direct welding unless otherwise indicated.
2. For galvanized railings, provide galvanized fittings, brackets, fasteners, sleeves, and other ferrous-metal components.
3. For non-galvanized railings, provide non-galvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors embedded in exterior masonry and concrete construction.

H. Fillers: Provide fillers made from steel plate, or other suitably crush-resistant material, where needed to transfer wall bracket loads through wall finishes to structural supports. Size fillers to suit wall finish thicknesses and to produce adequate bearing area to prevent bracket rotation and overstressing of substrate.

2.5 FINISHES

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

B. Finish metal stairs after assembly.

C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
2. 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.

D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with [SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."]:]

1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

E. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.6 STAINLESS-STEEL FINISHES

A. Remove tool and die marks and stretch lines, or blend into finish.

B. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

C. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.

D. 320-Grit Polished Finish: Oil-ground, uniform, fine, directionally textured finish.

E. Polished and Buffed Finish: Oil-ground, 180-grit finish followed by buffing.

F. Directional Satin Finish: No. 4.

G. Dull Satin Finish: No. 6.

H. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

F. Field Welding: Comply with requirements for welding in "Fabrication, General" Article.

G. Place and finish concrete fill for treads and platforms to comply with Division 3 Section "Cast-in-Place Concrete."

1. Install abrasive nosings with anchors fully embedded in concrete. Center nosings on tread width.

H. Install precast concrete treads with adhesive supplied by manufacturer.

3.2 INSTALLING METAL STAIRS WITH GROUTED BASEPLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of baseplates.

B. Set steel stair baseplates on wedges, shims, or leveling nuts. After stairs have been positioned and aligned, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use nonmetallic, non-shrink grout unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated or, if not indicated, as required by design loads. Plumb posts in each direction. Secure posts and rail ends to building construction as follows:

1. Anchor posts to steel by welding directly to steel supporting members.
2. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

B. Attach handrails to wall with wall brackets. Use type of bracket [[with predrilled hole for exposed bolt anchorage]. Provide bracket with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not

indicated, at spacing required to support structural loads. Secure wall brackets to building construction.] [as follows:]

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in [Division 9 painting Sections.]

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

D. Clean stainless steel by washing thoroughly with clean water and soap and rinsing with clean water.

END OF SECTION 05 51 00

SECTION 05 52 13 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Steel pipe railings.

B. Related Sections:

1. Division 05 Section "Metal Stairs" for steel tube railings associated with metal stairs.
2. Division 5 Section “Metal Fabrications”

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:

1. Steel: 72 percent of minimum yield strength.
2. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.

C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
b. Infill load and other loads need not be assumed to act concurrently.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.4 SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

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

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

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

1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
2. Fittings and brackets.
3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.

a. Show method of finishing, connecting members at intersections.

E. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

F. Qualification Data: For qualified professional engineer.

G. Welding certificates.

H. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

I. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

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

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate dimensions on shop drawings.

1. Provide allowance for trimming and fitting at site..

1.7 COORDINATION AND SCHEDULING

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Steel Pipe and Tube Railings:

    a. Pisor Industries, Inc.
    b. Wagner, R & B, Inc.; a division of the Wagner Companies.

2.2 METALS, GENERAL

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

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

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed).

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

1. Provide galvanized finish for exterior installations and where indicated.

C. Plates, Shapes, and Bars: ASTM A 36/A 36M.

D. Woven-Wire Mesh: Intermediate-crimp, square pattern, 2-inch (50-mm) woven-wire mesh, made from 0.135-inch (3.5-mm) nominal diameter wire complying with ASTM A 510 (ASTM A 510M).

2.4 FASTENERS

A. General: Provide the following:

1. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
2. Aluminum Railings: Type 304 stainless-steel fasteners.

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

C. Fasteners for Interconnecting Railing Components:

1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
2. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless exposed fasteners are unavoidable or are the standard fastening method for railings indicated.

3. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 (A1) stainless-steel bolts complying with ASTM F 593 (ASTM F 738M) and nuts complying with ASTM F 594 (ASTM F 836M

2.5 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Shop Primers: Provide primers that comply with Division 09 painting Sections.

E. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

F. Intermediate Coats and Topcoats: Provide products that comply with Division 09 painting Sections.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

H. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

I. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.

1. Water-Resistant Product: At exterior locations provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

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

B. Assemble railings 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.

C. 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.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with welded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove flux immediately.
4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction as follows:

1. As detailed.
2. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch (6 mm) or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

O. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

P. Woven-Wire Mesh Infill Panels: Fabricate infill panels from woven-wire mesh crimped into 1-by-1/2-by-1/8-inch (25-by-13-by-3-mm) metal channel frames. Make wire mesh and frames from same metal as railings in which they are installed.

1. Orient wire mesh with wires perpendicular and parallel to top rail.

2.7 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.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

2.8 STEEL AND IRON FINISHES

A. Galvanized Railings:

1. Hot-dip galvanize steel and iron railings, including hardware, after fabrication.
2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
4. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
5. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.

B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.

C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.

D. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.

E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Other Railings: SSPC-SP 3, "Power Tool Cleaning."

F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Division 09 painting Sections.
2. Do not apply primer to galvanized surfaces.

G. Shop-Painted Finish: Comply with Division 09 Section "Exterior Painting."

1. Color: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

3.3 RAILING CONNECTIONS

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

3.4 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts have been inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches (125 mm) deep and 3/4 inch (20 mm) larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.

D. Leave anchorage joint exposed with 1/8-inch (3-mm) buildup, sloped away from post.

E. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

F. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets. Provide brackets with 1-1/2-inch (38-mm) clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.6 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

3.7 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

B. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units.

END OF SECTION 05 52 13

SECTION 07 13 11 - BITUMINOUS DAMPPROOFING

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 [**hot-applied**] [**cold-applied, cut-back**] [**and**] [**cold-applied, emulsified-**] asphalt dampproofing applied to the following surfaces:

1. Exterior, below-grade surfaces of [**concrete**] [**and**] [**masonry**] foundation walls.
2. Back side of [**concrete**] [**and**] [**masonry**] retaining walls, below grade.
3. Exterior face of [**concrete**] [**and**] [**masonry**] indicated to receive [**stone veneer assemblies**] [**and**] [**dimension stone cladding**].
4. Exterior face of inner wythe of exterior masonry cavity walls.
5. Interior face of exterior [**concrete**] [**and**] [**masonry**] walls, above grade.

B. Related Sections include Division 07 Section "[**Self-Adhering Sheet**] [**Elastomeric Sheet**] [**Thermoplastic Sheet**] [**Cold Fluid-Applied**] [**Hot Fluid-Applied**] Waterproofing" for waterproofing.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.

B. Material Certificates: For each product, signed by manufacturers.

C. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

D. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.5 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit asphalt dampproofing to be performed according to manufacturers' written instructions.

B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has thoroughly cured.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Hot-Applied Asphalt Dampproofing:

    a. Meadows, W. R., Inc.
    b. Owens Corning; Trumbull Division.
    c. <**Insert manufacturer's name.**>

2. Cold-Applied, Cut-Back (Solvent-Based) Asphalt Dampproofing:

    a. Gardner Asphalt Corporation.
    b. Henry Company.
    c. Karnak Corporation.
    d. Koppers Industries, Inc.
    e. Malarkey Roofing Company.
    f. Meadows, W. R., Inc.
    g. Sonneborn, Div. of ChemRex, Inc.
    h. Tamms Industries.
    i. <**Insert manufacturer's name.**>

3. Cold-Applied, Emulsified-Asphalt Dampproofing:

    a. Euclid Chemical Company (The).
    b. Gardner Asphalt Corporation.
    c. Henry Company.
    d. Karnak Corporation.
    e. Koppers Industries, Inc.
    f. Malarkey Roofing Company.
    g. Meadows, W. R., Inc.
    h. Sonneborn, Div. of ChemRex, Inc.
    i. Tamms Industries.

j. <**Insert manufacturer's name.**>

4. Protection Course, Asphalt-Board Type:

a. Grace, W. R. & Co.; Construction Products Div.
b. Meadows, W. R., Inc.
c. Sonneborn, Div. of ChemRex, Inc.
d. <**Insert manufacturer's name.**>

2.2 BITUMINOUS DAMPPROOFING

A. Odor Elimination: For interior and concealed-in-wall uses [**other than exterior face of inner wythe of cavity walls**], provide dampproofing material warranted by manufacturer to be substantially odor free after drying for 24 hours under normal conditions.

B. Hot-Applied Asphalt Dampproofing: ASTM D 449, Type I.

C. Cold-Applied, Cut-Back (Solvent-Based) Asphalt Dampproofing:

1. Trowel Coats: ASTM D 4586, Type I.
2. Brush and Spray Coats: ASTM D 4479, Type I.

D. Cold-Applied, Emulsified-Asphalt Dampproofing:

1. Trowel Coats: ASTM D 1227, Type II, Class 1.
2. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
3. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.3 MISCELLANEOUS MATERIALS

A. Cut-Back Asphalt Primer: ASTM D 41.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

D. Protection Course, Asphalt-Board Type: Premolded, 1/8-inch- (3-mm-) thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on 1 side with polyethylene film.

E. Protection Course, Polystyrene Type: Fan-folded, rigid, extruded-polystyrene board insulation; nominal thickness not less than 3/16 inch (5 mm).

F. Protection Course, Roll-Roofing Type: Smooth-surfaced roll roofing complying with ASTM D 224, Type II.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Applicator present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.

1. Begin dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection of Other Work: Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply additional coats if recommended by manufacturer or required to achieve coverages indicated.
2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats.

B. Apply dampproofing to footings and foundation walls where opposite side of wall faces [**building interior**] [**occupied space**] whether indicated or not.

1. Apply from finished-grade line to top of footing, extend over top of footing, and down a minimum of 6 inches (150 mm) over outside face of footing.
2. Extend 12 inches (300 mm) onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
3. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat required for embedding fabric is in addition to other coats required.

C. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.

1. Lap dampproofing at least 1/4 inch (6 mm) onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch (6 mm) onto shelf angles supporting veneer.

D. Apply dampproofing to provide continuous plane of protection on interior face of above grade, exterior [**concrete**] [**and**] [**masonry**] [**single-wythe masonry**] walls unless walls are indicated to receive direct application of paint.

1. Continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by delaying construction of intersecting walls until dampproofing is applied.

E. Contractor's Options: Provide [**hot-applied**] [**cold-applied, cut-back**] [**or**] [**cold-applied, emulsified-**] asphalt dampproofing, as specified in subsequent articles for substrates indicated, within the following limitations:

1. Use hot-applied asphalt dampproofing only on [**exterior, below-grade surfaces of building**] [**and**] [**back sides of retaining walls**].
2. Use cold-applied, cut-back asphalt dampproofing only on exterior surfaces of building[**and exterior face of inner wythe of cavity walls**].
3. Use cold-applied, emulsified-asphalt dampproofing on [**surfaces other than below-grade exterior surfaces**] [**any surface indicated to receive dampproofing**].

3.4 HOT-APPLIED ASPHALT DAMPPROOFING

A. Do not apply hot asphalt when substrate condition causes foaming.

B. Prime masonry and other porous substrates.

C. Apply a uniform coat of hot asphalt by mopping or spraying at not less than 20 lb or 2.5 gal./100 sq. ft. (98 kg or 1 L/sq. m).

D. Apply a second coat [**to below-grade foundation walls**]as specified above. Apply double thickness of second coat where first application has failed to produce a smooth, shiny, impervious coat.

3.5 COLD-APPLIED, CUT-BACK ASPHALT DAMPPROOFING

A. On Concrete Foundations[**and Parged Masonry Foundation Walls**]: Apply two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. On Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, or primer and one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

C. On Unparged Masonry Foundation Walls: Apply primer and one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

D. On Backs of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

E. On Backs of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

F. On Concrete Backup for [**Stone Veneer Assemblies**] [**and**] [**Dimension Stone Cladding**]: Apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

G. On Masonry Backup for [**Stone Veneer Assemblies**] [**and**] [**Dimension Stone Cladding**]: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

H. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.6 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. On Concrete Foundations[**and Parged Masonry Foundation Walls**]: Apply two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or one trowel coat at not less than 4 gal./100 sq. ft. (1.6 L/sq. m).

B. On Unparged Masonry Foundation Walls: Apply primer and two brush or spray coats at not less than 1.5 gal./100 sq. ft. (0.6 L/sq. m) for first coat and 1 gal./100 sq. ft. (0.4 L/sq. m) for second coat, primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m), or primer and one trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).

C. On Unparged Masonry Foundation Walls: Apply primer and one trowel coat at not less than 5 gal./100 sq. ft. (2 L/sq. m).

D. On Backs of Concrete Retaining Walls: Apply one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

E. On Backs of Masonry Retaining Walls: Apply primer and one brush or spray coat at not less than 1.25 gal./100 sq. ft. (0.5 L/sq. m).

F. On Concrete Backup for [**Stone Veneer Assemblies**] [**and**] [**Dimension Stone Cladding**]: Apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

G. On Masonry Backup for [**Stone Veneer Assemblies**] [**and**] [**Dimension Stone Cladding**]: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

H. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

I. On Interior Face of Exterior Concrete Walls: Where above grade and indicated to be furred and finished, apply one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

J. On Interior Face of [**Single-Wythe**]Exterior Masonry Walls: Where above grade and indicated to be furred and finished, apply primer and one brush or spray coat at not less than 1 gal./100 sq. ft. (0.4 L/sq. m).

3.7 INSTALLATION OF PROTECTION COURSE

A. Where indicated, install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course. Support protection course with spot application of trowel-grade mastic where not otherwise indicated.

3.8 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION 07 11 13

SECTION 07 18 00 – TRAFFIC COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings”
2. Division 07 Section, “Joint Sealants”
3. Division 07 Section, “Expansion Joint Assemblies”

B. This Section includes traffic topping: Fluid applied, waterproofing, traffic-bearing elastomeric membrane with integral wearing surface, where the surface to which membrane is to be applied is one or more of the following:

1. Over occupied space.
2. Roof top parking.

C. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.

D. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 03 Section, "Cast-in-Place Concrete."
2. Division 07 Section, “Concrete Joint Sealants”
3. Division 07 Section, “Expansion Joint Assemblies”
4. Division 09 Section, "Pavement Markings."

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.

B. Pre-installation Conference: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful topping performance. Require every party concerned with topping

Work, or required to coordinate with it or protect it thereafter, to attend. Include manufacturer's technical representative and warranty officer.

C. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures:”

1. See requirements of Division 01 Section, “Submittal Procedures,” Part for limits to resubmittals.
2. See requirements of Division 01 Section, “Submittal Procedures,” for RFI constraints.

D. Submittals and Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer’s services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

E. Requests For Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate
3. Material, and wet mils required to obtain specified dry thickness for each coat.
4. Type, gradation and aggregate loading required within each coat.

B. Samples:

1. One 4 in. by 4 in. stepped sample showing each component for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates
   1. Certification that products and installation comply with applicable federal, state of California, and local EPA, OSHA and VOC requirements regarding health and safety hazards. VOC shall also comply with South Coast Air Quality Management in southern California (SCAQMD) Rule 1113.
   2. Evidence of applicator's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
   3. Certification from the Manufacturer that finishes as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive traffic topping.
   4. Certification stating static coefficient of friction meets minimum requirements of Americans with Disabilities Act (ADA).
   5. Certification stating materials have been tested and listed for UL 790 Class "A" rated materials/system by UL for traffic topping application specified on project. Containers shall bear UL labels.
   6. Certification from manufacturer confirming compatibility with existing underlying coatings and/or substrate.

B. Manufacturer's Instructions: for each system indicated.

   1. Crack treatment and surface preparation method and acceptance criteria.
   2. Method of application of each coat.
   3. Maximum and minimum allowable times between coats.
   4. Final cure time before resumption of parking and/or paint striping.
   5. Any other special instructions required to ensure proper installation.

C. Field Quality Control:

   1. Quality Control Plan as defined in Part 3.
   2. Two copies each of manufacturer's technical representative's log for each visit.
   3. Testing agency field reports.

D. Qualification Statements

   1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
   2. Installer's qualifications as defined in the "Quality Assurance" article.
   3. Signed statement from applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

    a. Name and location of project.
    b. Type of system applied.
    c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of compliance with Summary article paragraph "A single installer. . ."
2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications

1. Traffic Topping shall satisfy the current National Volatile Organic Compound (VOC) Emission Standards for Architectural Coatings.
2. Licensing/certification document from manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of California.
3. Licensing/certification agreement shall include following information:

    a. Applicator's financial responsibility for warranty burden under agreement terms.
    b. Manufacturer's financial responsibility for warranty burden under agreement terms.
    c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
    d. Authorized signatures for both Applicator Company and Manufacturer.
    e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

A. System Manufacturer New Application: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and applicator with regard to warranty requirements (Joint and Several). The warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Spalling surfaces.
3. Weathering.
4. Surface crazing (does not apply to traffic topping protection course).
5. Abrasion or tear failure resulting from normal traffic use.
6. Failure to bridge cracks less than 0.0625 in. or cracks existing at time of traffic topping installation on double tees only.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. BASF Building Systems (BASF), Shakopee, MN.
2. Carlisle Coating & Waterproofing(CCW), Inc., Sapulpa, OK.
3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
4. Neogard Division of Jones-Blair Company (Neogard), Dallas, TX.
5. Pacific Polymers, Inc. a Division of ITW (Pacific Polymers), Garden Grove, CA
6. Poly-Carb Inc. (Poly-Carb), Solon, OH.
7. Polycoat Products Division of Amer. Polymers (Polycoat), Santa Fe Springs, CA.
8. Sika Corporation (Sika), North Canton, OH.
9. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, TRAFFIC TOPPING

A. Acceptable low odor toppings are listed below. One will be selected as an alternate. In bid form, list bid price for each topping listed below. Contract for topping will not necessarily be directed to lowest bid priced topping. Toppings shall be compatible with all other materials in this Section and related work.

1. VOC Compliant, **Extreme** Low Odor, High-Solids (100%), Heavy Duty Coating System):

   a. AutoGard FC HD48, Neogard.
   b. Conipur II Deck Coating System, BASF.
   c. Flexodeck Mark 170.2, Poly-Carb.
   d. Iso-Flex 760 U HL AR and 760 U HL AL, Lymtal.
   e. Kelmar FCW III, exposure 2 or 3, TBS.
   f. Vulkem 360NF/950NF and 951NF, Tremco.
   g. Approved product similar in design, construction, and performance.

B. Provide ultraviolet screening for all traffic topping placed on this project.

C. Finish top coat shall be colored grey.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning surface preparation and application:

1. Concrete surfaces are finished as acceptable for system to be installed. Correct all high points, ridges, and other defects in a manner acceptable to the Engineer/Architect.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.
4. Joint Sealants are compatible with traffic toppings.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Acid etching is prohibited.

C. Remove all laitance and surface contaminants, including oil, grease and dirt by shotblasting. Prepare by sandblasting all surfaces inaccessible to shotblast equipment.

D. Before applying materials, apply system to small area to assure that it will adhere to substrate and joint sealants and dry properly and to evaluate appearance.

E. All cracks on concrete surface shall be prepared in accordance with manufacturer's recommendations.

F. Mask off adjoining surfaces not to receive traffic topping and mask off drains to prevent spillage and migration of liquid materials outside membrane area. Provide neat/straight lines at termination of traffic topping.

3.3 INSTALLATION/APPLICATION

A. Do all Work in accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric conditions

(including relative humidity and temperature), coverages, mil thicknesses and texture, and as shown on Drawings.

B. A primer coat is required for all systems. No exception.

C. Do not apply traffic topping material until concrete has been air dried at temperatures at or above 40ºF. for at least 30 days after curing period specified.

D. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

E. All adjacent vertical surfaces shall be coated with traffic topping minimum of 4 in. above coated horizontal surface. Requirement includes, but is not limited to pipes, columns, walls, curbs (full height of vertical faces of all curbs) and islands.

F. Complete all Work under this Section before painting line stripes.

G. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

3.4 FIELD QUALITY CONTROL

A. Develop a quality control plan for assured specified uniform membrane thickness that utilizes grid system of sufficiently small size to designate coverage area of not more than 5 gallons at specified thickness. In addition, employ wet mil gauge to continuously monitor thickness during application. Average specified wet mil thickness shall be maintained within grid during application with minimum thickness of not less than 80% of average acceptable thickness. Immediately apply more material to any area not maintaining these standards.

B. Testing Agency employ wet mil gauge to periodically monitor thickness during application.

C. Install 1 trial section of topping system for each duty grade specified. Do not proceed with further topping application until trial sections accepted in writing by Engineer/Architect. Remove and replace rejected trial sections with acceptable application. Trial section shall also be tested for:

1. Wet mil thickness application.
2. Adhesion to concrete substrate.
3. Overall dry mil thickness.

D. Use trial sections to determine adequacy of pre-application surface cleaning. Obtain Owner, Engineer/Architect and manufacturer acceptance of cleaning before proceeding with topping application.

E. Determine overall topping system mil thickness:

1. Contractor shall provide 6 in. by 6 in. bond breaker (topping coupon) on concrete surface for each 25,000 sq ft, or fraction thereof, of topping to be placed as directed by Engineer/Architect and manufacturer. Dimensionally locate coupon for easy removal.
2. Contractor shall assist Testing Agency in removing topping coupons from concrete surface at completion of manufacturer-specified cure period. Contractor shall repair coupon area per topping manufacturer's instructions.
3. Testing Agency shall determine dry mil thickness of completed Traffic Topping System, including bond breaker. Take 9 readings (minimum), 3 by 3 pattern at 2 in. on center. No reading shall be taken closer than 1 in. from coupon edge. Report individual readings and overall topping system average to Engineer/Architect. Readings shall be made with micrometer or optical comparator.

END OF SECTION 07 18 00

SECTION 07 53 23 - EPDM ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Adhered EPDM membrane roofing system.
2. Mechanically fastened EPDM membrane roofing system.
3. Loosely laid and ballasted EPDM membrane roofing system.
4. Vapor retarder.
5. Roof insulation.

B. Section includes the installation of acoustical roof deck rib insulation strips furnished under Division 05 Section "Steel Decking."

C. Related Sections:

1. Division 05 Section "Steel Decking" for furnishing acoustical deck rib insulation.
2. Division 07 Section "Thermal Insulation" for insulation beneath the roof deck.
3. Division 07 Section "Membrane Reroofing Preparation" for recover board beneath new membrane roofing.
4. Division 07 Section "Sheet Metal Flashing and Trim" for metal roof penetration flashings, flashings, and counterflashings.
5. Division 07 Section "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
6. Division 22 Section "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Installed membrane roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather

without failure due to defective manufacture, fabrication, installation, or other defects in construction. Membrane roofing and base flashings shall remain watertight.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by membrane roofing manufacturer based on testing and field experience.

C. Roofing System Design: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

1. Corner Uplift Pressure: <**Insert lbf/sq. ft. (kPa/sq. m)**>.
2. Perimeter Uplift Pressure: <**Insert lbf/sq. ft. (kPa/sq. m)**>.
3. Field-of-Roof Uplift Pressure: <**Insert lbf/sq. ft. (kPa/sq. m)**>.

D. FM Approvals Listing: Provide membrane roofing, base flashings, and component materials that comply with requirements in FM Approvals 4450 and FM Approvals 4470 as part of a membrane roofing system, and that are listed in FM Approvals' "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Approvals' markings.

1. Fire/Windstorm Classification: [**Class 1A-60**] [**Class 1A-75**] [**Class 1A-90**] [**Class 1A-105**] [**Class 1A-120**] <**Insert class**>.
2. Hail Resistance: [**MH**] [**SH**].

E. Energy Performance: Provide roofing system with initial Solar Reflectance Index not less than [**78**] [**29**] when calculated according to ASTM E 1980 based on testing identical products by a qualified testing agency.

F. Energy Performance: Provide roofing system that is listed on the DOE's ENERGY STAR "Roof Products Qualified Product List" for [**low**] [**steep**]-slope roof products.

G. Energy Performance: Provide roofing system with initial solar reflectance not less than [**0.70**] <**Insert value**> and emissivity not less than [**0.75**] <**Insert value**> when tested according to CRRC-1.

1.5 SUBMITTALS

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

B. LEED Submittals:

1. Product Test Reports for Credit SS 7.2: For roof materials, documentation indicating that roof materials comply with Solar Reflectance Index requirement.
2. Product Data for Credit EQ 4.1: For adhesives and sealants, including printed statement of VOC content.

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

1. Base flashings and membrane terminations.
2. Tapered insulation, including slopes.
3. Roof plan showing orientation of steel roof deck and orientation of membrane roofing and fastening spacings and patterns for mechanically fastened membrane roofing.
4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

D. Samples for Verification: For the following products, in manufacturer's standard sizes:

1. Sheet roofing, of color specified, including T-shaped side and end lap seam.
2. Roof insulation.
3. 10 lb (4.5 kg) of aggregate ballast in gradation[**and color**] indicated.
4. Roof paver[**, full sized,**] in each color and texture required.
5. Walkway pads or rolls.
6. Termination bars.
7. Battens.
8. Six insulation fasteners of each type, length, and finish.
9. Six roof cover fasteners of each type, length, and finish.

E. Qualification Data: For qualified Installer and manufacturer.

F. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for components of membrane roofing system.

H. Research/Evaluation Reports: For components of membrane roofing system, from the ICC-ES.

I. Field quality-control reports.

J. Maintenance Data: For membrane roofing system to include in maintenance manuals.

K. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for membrane roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by membrane roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

C. Source Limitations: Obtain components including roof insulation and fasteners for membrane roofing system from same manufacturer as membrane roofing.

D. Exterior Fire-Test Exposure: ASTM E 108, [**Class A**] [**Class B**] [**Class C**]; for application and roof slopes indicated, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Where indicated, provide fire-resistance-rated roof assemblies identical to those of assemblies tested for fire resistance per ASTM E 119 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Preliminary Roofing Conference: Before starting roof deck construction, conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
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 requirements for deck substrate conditions and finishes, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

G. Preinstallation Roofing Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
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. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.

6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck.

1.8 PROJECT CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard or customized form, without monetary limitation, in which manufacturer agrees to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, [**roof insulation,**] **fasteners, substrate board,**] [**roofing accessories,** and other components of membrane roofing system.
2. Warranty Period: [**10**] [**15**] [**20**] <**Insert number**> years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of membrane roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

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

PART 2 - PRODUCTS

2.1 EPDM MEMBRANE ROOFING

A. EPDM: ASTM D 4637, [**Type I, non-reinforced,**] [**Type II, scrim or fabric internally reinforced,**] uniform, flexible EPDM sheet.

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. Carlisle SynTec Incorporated.
b. ERSystems.
c. Firestone Building Products.
d. GAF Materials Corporation.
e. GenFlex Roofing Systems.
f. International Diamond Systems.
g. Johns Manville.
h. Mule-Hide Products Co., Inc.
i. Protective Coatings, Inc.
j. Roofing Products International, Inc.
k. StaFast Building Products.
l. Versico Incorporated.

2. Thickness: [**45 mils (1.1 mm)**] [**60 mils (1.5 mm)**] [**75 mils (1.9 mm)**] [**90 mils (2.2 mm)**] <**Insert thickness**>, nominal.
3. Exposed Face Color: White on black

B. Fabric-Backed EPDM: ASTM D 4637, Type III, non-reinforced, uniform, flexible EPDM sheet, laminated to a nonwoven polyester fabric backing except at selvages.

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. Carlisle SynTec Incorporated.
b. Versico Incorporated.

2. Composite Thickness: [**90 mils (2.3 mm)**] [**100 mils (2.5 mm)**] [**105 mils (2.7 mm)**] [**115 mils (2.9 mm)**], nominal.

3. Exposed Face Color: White on black

2.2 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
2. Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Contact Adhesive: 80 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Nonmembrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.
i. Sealant Primers for Porous Substrates: 775 g/L.
j. Other Adhesives and Sealants: 250 g/L.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet, 55- to 60-mil- (1.4- to 1.5-mm-) thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

D. Bonding Adhesive: Manufacturer's standard, water based.

E. Modified Asphaltic Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard modified asphalt, asbestos-free, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

F. Water-Based, Fabric-Backed Membrane Adhesive: Roofing system manufacturer's standard water-based, cold-applied adhesive formulated for compatibility and use with fabric-backed membrane roofing.

G. Low-Rise, Urethane, Fabric-Backed Membrane Adhesive: Roof system manufacturer's standard spray-applied, low-rise, two-component urethane adhesive formulated for compatibility and use with fabric-backed membrane roofing.

H. Seaming Material: [**Single-component, butyl splicing adhesive and splice cleaner**] [**Manufacturer's standard, synthetic-rubber polymer primer and 3-inch- (75-mm-) wide minimum, butyl splice tape with release film**].

I. Lap Sealant: Manufacturer's standard, single-component sealant[**, colored to match membrane roofing**].

J. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

K. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

L. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick (25 mm wide by 1.3 mm thick), prepunched.

M. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

N. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

O. Liquid coating, specifically formulated for coating EPDM membrane roofing, as follows:

1. Type: [**Acrylic emulsion**] [**Hypalon**].
2. Color: [**White**] [**Gray**] [**Tan**] [**As selected by Architect from manufacturer's full range**] <**Insert color**>.

2.3 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1396/C 1396M, Type X gypsum board, 5/8 inch (16 mm) thick.

B. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, [**1/4 inch (6 mm)**] [**1/2 inch (13 mm)**] [**Type X, 5/8 inch (16 mm)**] thick.

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. Georgia-Pacific Corporation; Dens Deck.

C. Substrate Board: ASTM C 1278/C 1278M, cellulosic-fiber-reinforced, water-resistant gypsum substrate, [**1/4 inch (6 mm)**] [**3/8 inch (10 mm)**] [**1/2 inch (13 mm)**] [**5/8 inch (16 mm)**] thick.

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. USG Corporation; Securock.

D. Substrate Board: ASTM C 728, perlite board, [**3/4 inch (19 mm)**] [**1 inch (25 mm)**] thick, seal coated.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.4 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by EPDM membrane roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Approvals-approved roof insulation.

B. Extruded-Polystyrene Board Insulation: ASTM C 578, [**Type IV, 1.6-lb/cu. ft. (26-kg/cu. m)**] [**Type X, 1.3-lb/cu. ft. (21-kg/cu. m)**] minimum density, square edged.

C. Molded-Polystyrene Board Insulation: ASTM C 578, [**Type II, 1.35-lb/cu. ft. (22-kg/cu. m)**] [**Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m)**] [**Type IX, 1.8-lb/cu. ft. (29-kg/cu. m)**] minimum density.

D. Composite Molded-Polystyrene Board Insulation: ASTM C 578, [**Type II, 1.35-lb/cu. ft. (22-kg/cu. m)**] [**Type VIII, 1.15-lb/cu. ft. (18-kg/cu. m)**] [**Type IX, 1.8-lb/cu. ft. (29-kg/cu. m)**] minimum density, with factory-applied facings, as follows:

1. Facer: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, asphalt coated, 1/2 inch (13 mm) thick.
2. Facer: DOC PS 2, Exposure 1, OSB, 7/16 inch (11 mm) thick.

E. Polyisocyanurate Board Insulation: ASTM C 1289, [**Type II, Class 1, Grade 2**] [**Type II, Class I, Grade 3**], felt or glass-fiber mat facer on both major surfaces.

F. Composite Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 2 with factory-applied facing board on one major surface, as indicated below by type, and felt or glass-fiber mat facer on the other.

1. Type IV, cellulosic-fiber-insulation-board facer, Grade 2, 1/2 inch (13 mm) thick.
2. Type V, OSB facer, 7/16 inch (11 mm) thick.
3. Type VII, glass mat faced gypsum board facer, 1/4 inch (6 mm) thick.

G. Perlite Board Insulation: ASTM C 728, rigid, mineral-aggregate thermal insulation board composed of expanded perlite, cellulosic fibers, binders, and waterproofing agents with top surface seal coated.

H. Cellulosic-Fiber Board Insulation: ASTM C 208, Type II, Grade 2, fibrous-felted, rigid insulation boards of wood fiber or other cellulosic-fiber and water-resistant binders, asphalt impregnated, chemically treated for deterioration.

I. Cellular-Glass Board Insulation: ASTM C 552, Type IV, rigid, cellular-glass thermal board insulation faced with manufacturer's standard kraft-paper sheets.

J. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of [**1/4 inch per 12 inches (1:48)**] unless otherwise indicated.

K. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. General: Furnish roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with membrane roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation[**and cover boards**] to substrate, and acceptable to roofing system manufacturer.

C. Modified Asphaltic Insulation Adhesive: Insulation manufacturer's recommended modified asphalt, asbestos-free, cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

D. Bead-Applied Insulation Adhesive: Insulation manufacturer's recommended bead-applied, low-rise, one- or multicomponent urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

E. Full-Spread Applied Insulation Adhesive: Insulation manufacturer's recommended spray-applied, low-rise, two-component urethane adhesive formulated to attach roof insulation to substrate or to another insulation layer.

F. Cover Board: ASTM C 208, Type II, Grade 2, cellulosic-fiber insulation board, 1/2 inch (13 mm) thick.

G. Cover Board: DOC PS 2, Exposure 1, OSB, 7/16 inch (11 mm) thick.

H. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, [**1/4 inch (6 mm)**] [**1/2 inch (13 mm)**] [**5/8 inch (16 mm)**] thick[**, factory primed**].

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. Georgia-Pacific Corporation; [**Dens Deck**] [**Dens Deck Prime**] [**Dens Deck DuraGuard**].

I. Cover Board: ASTM C 1278/C 1278M, cellulosic-fiber reinforced, water-resistant gypsum substrate, [**1/4 inch (6 mm)**] [**3/8 inch (10 mm)**] [**1/2 inch (13 mm)**] [**5/8 inch (16 mm)**] thick.

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. USG Corporation; Securock.

J. Protection Mat: Woven or nonwoven polypropylene, polyolefin, or polyester fabric, water permeable and resistant to UV degradation, type and weight as recommended by roofing system manufacturer for application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that roof openings and penetrations are in place and curbs are set and braced and that roof drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Division 05 Section "Steel Decking."
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete curing compounds that will impair adhesion of roofing components to roof deck have been removed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

D. Install acoustical roof deck rib insulation strips, specified in Division 05 Section "Steel Decking," according to acoustical roof deck manufacturer's written instructions, immediately before installation of overlying construction and to remain dry.

3.3 SUBSTRATE BOARD

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Approvals' "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches (68 mm) or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches (150 mm) in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch (6 mm) with insulation.

1. Cut and fit insulation within 1/4 inch (6 mm) of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Prime surface of concrete deck with asphalt primer at rate of 3/4 gal./100 sq. ft. (0.3 L/sq. m) and allow primer to dry.
2. Set each layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
3. Set each layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.

4. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

I. Mechanically Fastened and Adhered Insulation: Install first layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.

1. Fasten first layer of insulation according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
3. Set each subsequent layer of insulation in a solid mopping of hot roofing asphalt, applied within plus or minus 25 deg F (14 deg C) of equiviscous temperature.
4. Set each subsequent layer of insulation in ribbons of bead-applied insulation adhesive, firmly pressing and maintaining insulation in place.
5. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

J. Loosely Laid Insulation: Loosely lay insulation units over substrate.

K. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches (150 mm) in each direction. Loosely butt cover boards together[**and fasten to roof deck**].

1. Fasten cover boards according to requirements in FM Approvals' "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.5 ADHERED MEMBRANE ROOFING INSTALLATION

A. Adhere [**fabric-backed**]membrane roofing over area to receive roofing according to membrane roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

B. Start installation of membrane roofing in presence of membrane roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of membrane roofing at rate required by manufacturer and allow to partially dry before installing membrane roofing. Do not apply to splice area of membrane roofing.

E. Hot Roofing Asphalt: Apply a solid mopping of hot roofing asphalt to substrate at temperature and rate required by manufacturer and install fabric-backed membrane roofing. Do not apply to splice area of membrane roofing.

F. Fabric-Backed Membrane Adhesive: Apply to substrate at rate required by manufacturer and install fabric-backed membrane roofing.

G. In addition to adhering, mechanically fasten membrane roofing securely at terminations, penetrations, and perimeters.

H. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

I. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

J. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

K. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

L. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

M. Install membrane roofing and auxiliary materials to tie in to existing membrane roofing to maintain weather-tightness of transition [**and to not void warranty for existing membrane roofing system**].

N. Adhere protection sheet over membrane roofing at locations indicated.

3.6 MECHANICALLY FASTENED MEMBRANE ROOFING INSTALLATION

A. Mechanically fasten membrane roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

1. For in-splice attachment, install membrane roofing with long dimension perpendicular to steel roof deck flutes.

B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere membrane roofing securely at terminations, penetrations, and perimeter of roofing.

E. Apply membrane roofing with side laps shingled with slope of roof deck where possible.

F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

H. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

I. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

J. In-Splice Attachment: Secure one edge of membrane roofing using fastening plates or metal battens centered within membrane splice and mechanically fasten membrane roofing to roof deck. Field splice seam.

K. Through-Membrane Attachment: Secure membrane roofing using fastening plates or metal battens and mechanically fasten membrane roofing to roof deck. Cover battens and fasteners with a continuous cover strip.

L. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weather-tightness of transition [**and to not void warranty for existing membrane roofing system**].

M. Adhere protection sheet over membrane roofing at locations indicated.

3.7 LOOSELY LAID AND BALLASTED MEMBRANE ROOFING INSTALLATION

A. Loosely lay membrane roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll membrane roofing and allow to relax before installing.

1. Comply with requirements in SPRI RP-4 for [**System 1**] [**System 2**] [**System 3**].

B. Start installation of membrane roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align membrane roofing, without stretching, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Mechanically fasten or adhere perimeter of membrane roofing according to requirements in SPRI RP-4.

E. [**Mechanically fasten**] [**or**] [**adhere**] membrane roofing at corners, perimeters, and transitions according to requirements in SPRI RP-4.

1. At corners and perimeters, omit aggregate ballast leaving membrane roofing exposed.
2. At corners and perimeters, adhere a second layer of membrane roofing

F. Apply membrane roofing with side laps shingled with slope of deck where possible.

G. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by membrane roofing system manufacturer.

H. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping membrane roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of membrane roofing terminations.

I. Leave seams uncovered until inspected by [**membrane roofing system manufacturer**] [**testing agency**].

J. Repair tears, voids, and lapped seams in roofing that does not comply with requirements.

K. Spread sealant or mastic bed over deck drain flange at roof drains and securely seal membrane roofing in place with clamping ring.

L. Install membrane roofing and auxiliary materials to tie in to existing roofing to maintain weather-tightness of transition [**and to not void warranty for existing membrane roofing system**].

M. Adhere protection sheet over membrane roofing at locations indicated.

N. Install protection mat over membrane roofing, overlapping a minimum of 6 inches (150 mm). Install an additional protection mat layer at projections, pipes, vents, and drains, overlapping a minimum of 12 inches (300 mm).

O. Aggregate Ballast: Apply uniformly over membrane roofing at the rate required by membrane roofing system manufacturer, but not less than the following, spreading with care to minimize possibility of damage to membrane roofing system. Lay ballast as membrane roofing is installed, leaving membrane roofing ballasted at the end of the workday.

1. Ballast Weight: Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m).
2. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m), at corners and perimeter; Size 4 aggregate, 10 lb/sq. ft. (50 kg/sq. m), elsewhere.
3. Ballast Weight: Size 2 aggregate, 13 lb/sq. ft. (65 kg/sq. m).
4. Ballast Weight: Size 3 aggregate, <**Insert weight**>, at corners, <**Insert weight**> at perimeter, and <**Insert weight**>, elsewhere.

P. Roof-Paver Ballast: Install [**lightweight**] [**heavyweight**] roof-paver ballast according to manufacturer's written instructions.

Q. Roof-Paver Ballast: Install rubber roof-paver ballast according to manufacturer's written instructions, in locations indicated.

1. Install perimeter paver edge securement.

R. Roof-Paver and Aggregate Ballast: Install heavyweight roof pavers according to manufacturer's written instructions on roof corners and perimeter.

1. Install Size 4 aggregate ballast elsewhere on roofing at a minimum rate of 10 lb/sq. ft. (50 kg/sq. m).
2. Install Size 2 aggregate ballast elsewhere on roofing at a minimum rate of 13 lb/sq. ft. (65 kg/sq. m).

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings[**and mechanically anchor to substrate through termination bars**].

3.9 COATING INSTALLATION

A. Apply coatings to [**membrane roofing**] [**base flashings**] according to manufacturer's written recommendations, by spray, roller, or other suitable application method.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: [**Owner will engage**] [**Engage**] a qualified independent testing agency to perform inspections.

B. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

D. Additional inspections, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates and repair or reinstall membrane roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER'S WARRANTY

A. WHEREAS <**Insert name**> of <**Insert address**>, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <**Insert name of Owner.**>
2. Address: <**Insert address.**>
3. Building Name/Type: <**Insert information.**>
4. Address: <**Insert address.**>
5. Area of Work: <**Insert information.**>
6. Acceptance Date: <**Insert date.**>
7. Warranty Period: <**Insert time.**>
8. Expiration Date: <**Insert date.**>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:

    a. Lightning;
    b. Peak gust wind speed exceeding <**Insert wind speed**> mph (m/sec);
    c. Fire;
    d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    f. Vapor condensation on bottom of roofing; and
    g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.
4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <**Insert day**> day of <**Insert month**>, <**Insert year**>.

1. Authorized Signature: <**Insert signature**>.
2. Name: <**Insert name**>.
3. Title: <**Insert title**>.

END OF SECTION 07 53 23

SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

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 sheet metal flashing and trim in the following categories:

1. Roof-drainage systems.
2. Exposed trim, gravel stops, and fasciae.
3. Copings.
4. Metal flashing.
5. Reglets.
6. Roof expansion-joint covers.
7. Overhead-piping safety pans.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 04 Sections for masonry flashings specified as part of masonry work.
2. Division 07 Section "Joint Sealants" for elastomeric sealants.

1.3 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.

B. Fabricate and install flashings at roof edges to comply with recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone:

1. Wind Zone 1: Wind pressures of 10 to 20 psf.
2. Wind Zone 2: Wind pressures of 21 to 30 psf.
3. Wind Zone 3: Wind pressures of 31 to 45 psf.
4. Wind Zone 4: Wind pressures of 46 to 104 psf.

1.4 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 01 Specification Sections.

B. Product Data including manufacturer's material and finish data, installation instructions, and general recommendations for each specified flashing material and fabricated product.

C. Shop Drawings of each item specified showing layout, profiles, methods of joining, and anchorage details.

D. Samples of sheet metal flashing, trim, and accessory items, in the specified finish. Where finish involves normal color and texture variations, include Sample sets composed of 2 or more units showing the full range of variations expected.

1. 8-in.- square Samples of specified sheet materials to be exposed as finished surfaces.
2. 12-in.- long Samples of factory-fabricated products exposed as finished Work. Provide complete with specified factory finish.

E. Qualification data for firms and persons specified in the "Quality Assurance" 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.

F. Resubmittals: Engineer will review each of Contractor's shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.

G. Request for Information Requirements:

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems already answered in the project documents.
3. RFI process shall not be used for requesting substitutions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experience Installer who has completed 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.

1.6 PROJECT CONDITIONS

A. Coordinate Work of this Section with interfacing and adjoining Work for proper sequencing of each installation. Ensure best possible weather resistance, durability of Work, and protection of materials and finishes.

PART 2 - PRODUCTS

2.1 METALS

A. Aluminum: Alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated and with not less than the strength and durability of alloy and temper designated below:

1. Mill-Finish Alclad Aluminum Sheet: ASTM B 209, Alclad 3003-H14, with a minimum thickness of 0.040 in., unless otherwise indicated.
2. Mill-Finish Aluminum Sheet: ASTM B 209, 3003-H14, with a minimum thickness of 0.040 in., unless otherwise indicated.
3. Anodized Aluminum Sheet: ASTM B 209, 5005-H14, with a minimum thickness of 0.050 in.
4. Factory-Painted Aluminum Sheet: ASTM B 209, 3003-H14, with a minimum thickness of 0.040 in., unless otherwise indicated.
5. Extruded Aluminum: ASTM B 221, alloy 6063-T52, with a minimum thickness of 0.080 in. for primary legs of extrusions that are anodized, unless otherwise indicated.

B. Stainless-Steel Sheet: ASTM A 167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187 in. thick, unless otherwise indicated.

C. Galvanized Steel Sheet: ASTM A 526, G 90, commercial quality, or ASTM A 527, G 90, lock-forming quality, hot-dip galvanized steel sheet with 0.20% copper, mill phosphatized where indicated for painting; not less than 0.0396 in. thick, unless otherwise indicated.

D. Coil-Coated Galvanized Steel Sheet: Zinc-coated, commercial-quality steel sheet conforming to ASTM A 755, G 90 coating designation, coil coated with high-performance fluoropolymer coating as specified in "Coil-Coated Galvanized Steel Sheet Finish" Article; not less than 0.0336 in. thick, unless otherwise indicated.

2.2 CONCEALED THROUGH-WALL SHEET METAL FLASHING

A. Material: Fabricate from the following metal:

1. Stainless Steel: 0.0156 in. thick.
2. Fabricate through-wall metal flashings embedded in masonry as follows:

a. With ribs formed in dovetail pattern at 3-in. (75-mm) intervals along length of flashing to provide a 3-way integral mortar bond and weep-hole drainage.
b. With ribs formed in sawtooth pattern at 3-in. (75-mm) intervals along length of flashing to provide a 3-way integral mortar bond and weep-hole drainage.

B. Products: Subject to compliance with requirements, provide 1 of the following:

1. Cheney Flashing (Dovetail); Cheney Flashing Company, Inc.
2. Cheney Flashing (Sawtooth); Cheney Flashing Company, Inc.
3. Keystone 3-Way Interlocking Thruwall Flashing; Keystone Flashing Co.

2.3 REGLETS

A. General: Units of type, material, and profile indicated, formed to provide secure interlocking of separate reglet and counterflashing pieces and compatible with flashing indicated.

B. 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.

C. Stucco Type: Provide with upturned fastening flange and extension leg of length to match thickness of applied finish materials.

D. Concrete Type: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.

E. Masonry Type: Provide with offset top flange for embedment in masonry mortar joint.

F. 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.

G. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of the counterflashing lower edge.

1. Material: Stainless steel, 0.0187 in. thick.
2. Material: Aluminum, 0.024 in. thick.
3. Material: Galvanized steel, 0.0217 in. thick.

H. Manufacturers: Subject to compliance with requirements, provide products by 1 of the following:

1. Fry Reglet Corporation.
2. Hickman: W.P. Hickman Co.
3. Keystone Flashing Company.

2.4 MISCELLANEOUS MATERIALS AND ACCESSORIES

A. Solder: ASTM B 32, Grade Sn50, used with rosin flux.

B. Solder for Stainless Steel: ASTM B 32, Grade Sn60, used with an acid flux of type recommended by stainless-steel sheet manufacturer; use a noncorrosive rosin flux over tinned surfaces.

C. Stainless-Steel Welding Rods: Type recommended by stainless-steel sheet manufacturer for type of metal sheets furnished.

D. Fasteners: Same metal as sheet metal flashing or other noncorrosive metal as recommended by sheet metal manufacturer. Match finish of exposed heads with material being fastened.

E. Asphalt Mastic: SSPC-Paint 12, solvent-type asphalt mastic, nominally free of sulfur and containing no asbestos fibers, compounded for 15-mil dry film thickness per coat.

F. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

G. Elastomeric Sealant: Generic type recommended by sheet metal manufacturer and fabricator of components being sealed and complying with requirements for joint sealants as specified in Division 07 Section "Joint Sealants."

H. Epoxy Seam Sealer: 2-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior and interior nonmoving joints, including riveted joints.

I. Adhesives: Type recommended by flashing sheet metal manufacturer for waterproof and weather-resistant seaming and adhesive application of flashing sheet metal.

J. Paper Slip Sheet: 5-lb/sq. red rosin, sized building paper conforming to FS UU-B-790, Type I, Style 1b.

K. Polyethylene Underlayment: ASTM D 4397, minimum 6-mil- thick black polyethylene film, resistant to decay when tested according to ASTM E 154.

L. Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of Work, matching or compatible with material being installed; noncorrosive; size and thickness required for performance.

M. Gutter Screen: 0.25-in. hardware cloth installed in sheet metal frames. Fabricate screen and frame of same basic material as gutters and downspouts.

N. Roofing Cement: ASTM D 4586, Type I, asbestos free, asphalt based.

2.5 FABRICATION, GENERAL

A. Sheet Metal Fabrication Standard: Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal, and other characteristics of the item indicated.

B. Comply with details shown to fabricate sheet metal flashing and trim that fit substrates and result in waterproof and weather-resistant performance once installed. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Form exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems.

D. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

E. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

F. Expansion Provisions: Space movement joints at maximum of 10 ft with no joints allowed within 24 in. of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 in. deep, filled with mastic sealant (concealed within joints).

G. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards.

H. Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces at locations of contact with asphalt mastic or other permanent separation as recommended by manufacturer.

I. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of sheet metal exposed to public view.

J. Fabricate cleats and attachment devices from same material as sheet metal component being anchored or from compatible, noncorrosive metal recommended by sheet metal manufacturer.

1. Size: As recommended by SMACNA manual or sheet metal manufacturer for application but never less than thickness of metal being secured.

2.6 SHEET METAL FABRICATIONS

A. General: Fabricate sheet metal items in thickness or weight needed to comply with performance requirements but not less than that listed below for each application and metal.

B. Gutters with Girth up to 15 in.: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0156 in. thick.
3. Galvanized Steel: 0.0217 in. thick.
4. Coil-Coated Galvanized Steel: 0.0217 in. thick.

C. Gutters with Girth 16 to 20 in.: Fabricate from the following material:

1. Aluminum: 0.040 in. thick.
2. Stainless Steel: 0.0187 in. thick.
3. Galvanized Steel: 0.0276 in. thick.
4. Coil-Coated Galvanized Steel: 0.0276 in. thick.

D. Downspouts: Fabricate from the following material:

1. Aluminum: 0.024 in. thick.
2. Stainless Steel: 0.0156 in. thick.
3. Galvanized Steel: 0.0217 in. thick.
4. Coil-Coated Galvanized Steel: 0.0217 in. thick.

E. Conductor Heads: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0156 in. thick.
3. Galvanized Steel: 0.0276 in. thick.
4. Coil-Coated Galvanized Steel: 0.0276 in. thick.

F. Splash Pans: Fabricate from the following material:

1. Aluminum: 0.040 in. thick.
2. Stainless Steel: 0.0187 in. thick.

G. Roof-Drain Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0156 in. thick.

H. Scuppers: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0187 in. thick.
3. Galvanized Steel: 0.0276 in. thick.
4. Coil-Coated Galvanized Steel: 0.0276 in. thick.

I. Exposed Trim, Gravel Stops, and Fasciae: Fabricate from the following material:

1. Aluminum: 0.050 in. thick.
2. Stainless Steel: 0.0187 in. thick.
3. Galvanized Steel: 0.0276 in. thick.
4. Coil-Coated Galvanized Steel: 0.0276 in. thick.

J. Copings: Fabricate from the following material:

1. Aluminum: 0.050 in. thick.
2. Stainless Steel: 0.0250 in. thick.
3. Galvanized Steel: 0.0396 in. thick.
4. Coil-Coated Galvanized Steel: 0.0396 in. thick.

K. Base Flashing: Fabricate from the following material:

1. Aluminum: 0.040 in. thick.
2. Stainless Steel: 0.0187 in. thick.
3. Galvanized Steel: 0.0276 in. thick.
4. Coil-Coated Galvanized Steel: 0.0276 in. thick.

L. Counterflashing: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0187 in. thick.
3. Galvanized Steel: 0.0217 in. thick.
4. Coil-Coated Galvanized Steel: 0.0217 in. thick.

M. Flashing Receivers: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0156 in. thick.
3. Galvanized Steel: 0.0217 in. thick.
4. Coil-Coated Galvanized Steel: 0.0217 in. thick.

N. Valley Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0187 in. thick.
2. Coil-Coated Galvanized Steel: 0.0276 in. thick.

O. Drip Edges: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0156 in. thick.
3. Galvanized Steel: 0.0217 in. thick.
4. Coil-Coated Galvanized Steel: 0.0217 in. thick.

P. Eave Flashing: Fabricate from the following material:

1. Aluminum: 0.0320 in. thick.
2. Stainless Steel: 0.0156 in. thick.
3. Galvanized Steel: 0.0217 in. thick.
4. Coil-Coated Galvanized Steel: 0.0217 in. thick.

Q. Equipment Support Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0187 in. thick.
2. Galvanized Steel: 0.0276 in. thick.

3. Coil-Coated Galvanized Steel: 0.0276 in. thick.

R. Roof-Penetration Flashing: Fabricate from the following material:

1. Stainless Steel: 0.0187 in. thick.
2. Galvanized Steel: 0.0276 in. thick.

S. Overhead-Piping Safety Pans: Fabricate from the following material:

1. Stainless Steel: 0.0250 in. thick.
2. Galvanized Steel: 0.0396 in. thick.

T. Roof Expansion-Joint Cover: Fabricate from the following material:

1. Aluminum: 0.040 in. thick.
2. Stainless Steel: 0.0187 in. thick.
3. Galvanized Steel: 0.0276 in. thick.
4. Coil-Coated Galvanized Steel: 0.0276 in. thick.

U. Roof-to-Wall Expansion-Joint Cover: Fabricate from the following material:

1. Aluminum: 0.050 in. thick.
2. Stainless Steel: 0.0250 in. thick.
3. Galvanized Steel: 0.0336 in. thick.
4. Coil-Coated Galvanized Steel: 0.0336 in. thick.

2.7 ALUMINUM EXTRUSION FABRICATIONS

A. Aluminum Extrusion Units: Fabricate extruded-aluminum running units with formed or extruded-aluminum joint covers for installation behind main members where possible. Fabricate mitered and welded corner units.

2.8 ALUMINUM FINISHES

A. General: Comply with Aluminum Association's (AA) "Designation System for Aluminum Finishes" for finish designations and application recommendations.

B. Class I, Clear Anodic Finish: AA-C22A41 (Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 607.1.

C. Class I, Color Anodic Finish: AA-C22A42/A44 (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 606.1 or AAMA 608.1.

1. Color: Light bronze.
2. Color: Medium bronze.
3. Color: Dark bronze.

4. Color: Black.
5. Color: Match Design Professional's sample.
6. Color: As selected by Design Professional from the full range of industry colors and color densities.

D. High-Performance Organic Coating Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight; complying with AAMA 605.2.

   a. Color and Gloss: As indicated by manufacturer's color and gloss designations.
   b. Color and Gloss: Match Design Professional's sample.
   c. Color and Gloss: As selected by Design Professional from manufacturer's full range of choices for color and gloss.

2.9 COIL-COATED GALVANIZED STEEL SHEET FINISH

A. High-Performance Organic Coating Finish: Apply the following system by coil-coating process on galvanized steel sheet as recommended by coating manufacturers and applicator.

1. Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat, thermocured system composed of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70% polyvinylidene fluoride resin by weight; complying with AAMA 605.2.

   a. Color and Gloss: As indicated by manufacturer's color and gloss designations.
   b. Color and Gloss: Match Design Professional's sample.
   c. Color and Gloss: As selected by Design Professional from manufacturer's full range of choices for color and gloss.
   d. Resin Manufacturers: Subject to compliance with requirements, provide fluoropolymer coating systems containing resins produced by 1 of the following manufacturers:

      1) Ausimont USA, Inc. (Hylar 5000)
      2) Elf Atochem North America, Inc. (Kynar 500)

2. Coil-Coated Steel Sheet Manufacturers: Subject to compliance with requirements, provide products by 1 of the following:

   a. Atas Aluminum Corporation.
   b. Copper Sales, Inc.

c. MM Systems Corporation.
d. Petersen Aluminum Corporation.
e. Vincent Metals.

B. Shop Finish, Rain Drainage: Provide manufacturer's standard baked-on, white-acrylic shop finish on sheet metal rain-drainage units (gutters, downspouts, and similar exposed units); 1.0-mil dry film thickness.

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.

3.2 INSTALLATION

A. General: Unless otherwise indicated, install sheet metal flashing and trim to comply with performance requirements, manufacturer's installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Anchor units of Work securely in place by methods indicated, providing for thermal expansion of metal units; conceal fasteners where possible, and set units true to line and level as indicated. Install Work with laps, joints, and seams that will be permanently watertight and weatherproof.

B. Install exposed sheet metal Work that is without excessive oil canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

C. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.

D. Expansion Provisions: Provide for thermal and seismic expansion of exposed sheet metal Work. Space movement joints at maximum of 10 ft with no joints allowed within 24 in. of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 in. deep, filled with mastic sealant (concealed within joints).

E. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1.5 in., except where pretinned surface would show in finished Work.

1. Do not solder the following metals:

a. Aluminum.

b. Coil-coated galvanized steel sheet.

2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

F. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.

1. Use joint adhesive for nonmoving joints specified not to be soldered.

G. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.

I. Separations: Separate metal from noncompatible metal or corrosive substrates by coating concealed surfaces, at locations of contact, with asphalt mastic or other permanent separation as recommended by manufacturer.

1. Underlayment: Where installing stainless steel or aluminum directly on cementitious or wood substrates, install a slip sheet of red-rosin paper and a course of polyethylene underlayment.
2. Bed flanges of Work in a thick coat of roofing cement where required for waterproof performance.

J. Install reglets to receive counterflashing according to the following requirements:

1. Where reglets are shown in concrete, furnish reglets for installation under Division 03 Section "Cast-in-Place Concrete."
2. Where reglets are shown in masonry, furnish reglets for installation under Division 04 Section "Unit Masonry."

K. Counterflashings: Coordinate installation of counterflashings with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2 in. and bed with sealant.

L. Roof-Drainage System: Install drainage items fabricated from sheet metal, with straps, adhesives, and anchors recommended by SMACNA's Manual or the item manufacturer, to drain roof in the most efficient manner. Coordinate roof-drain flashing installation with roof-drainage system installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.

M. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.

N. Equipment Support Flashing: Coordinate equipment support flashing installation with roofing and equipment installation. Weld or seal flashing to equipment support member.

O. Roof-Penetration Flashing: Coordinate roof-penetration flashing installation with roofing and installation of items penetrating roof. Install flashing as follows:

1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
2. Seal and clamp flashing to pipes penetrating roof, other than lead flashing on vent piping.

P. Splash Pans: Install where downspouts discharge on low-sloped roofs, unless otherwise shown. Set in roof cement or sealant compatible with roofing membrane.

Q. Install continuous gutter screens on gutters with noncorrosive fasteners, arranged as hinged units to swing open for cleaning gutters.

3.3 CLEANING AND PROTECTION

A. Clean exposed metal surfaces, removing substances that might cause corrosion of metal or deterioration of finishes.

B. Provide final protection and maintain conditions that ensure sheet metal flashing and trim Work during construction is without damage or deterioration other than natural weathering at the time of Substantial Completion.

END OF SECTION 07 62 00

SECTION 07 84 00 - PENETRATION FIRESTOPPING

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 through-penetration firestop systems for penetrations through the following fire-resistance-rated assemblies, including both empty openings and openings containing penetrating items:

1. Floors.
2. Roofs.
3. Walls and partitions.

B. Related Sections include the following:

1. Division 03 Section "Cast-in-Place Concrete" for construction of openings in concrete slabs and walls.

1.3 PERFORMANCE REQUIREMENTS

A. General: For the following constructions, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly penetrated.

1. Fire-resistance-rated non-load-bearing walls, including partitions, with fire-protection-rated openings.
2. Fire-resistance-rated floor assemblies.
3. Fire-resistance-rated roof assemblies.

B. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.

C. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:

1. Penetrations located outside fire-resistive shaft enclosures.

2. Penetrations located in construction containing fire-protection-rated openings.
3. Penetrating items larger than 4-inch- diameter nominal pipe or 16 sq. in. in overall cross-sectional area.

D. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that after curing do not deteriorate when exposed to these conditions both during and after construction.

1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved either by installing floor plates or by other means.

1.4 SUBMITTALS

A. Product Data: For each type of through-penetration firestop system product indicated.

B. Shop Drawings: For each through-penetration firestop system, show each kind of construction condition penetrated, relationships to adjoining construction, and kind of penetrating item. Include firestop design designation of testing and inspecting agency acceptable to authorities having jurisdiction that evidences compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
2. Where Project conditions require modification of qualified testing and inspecting agency's illustration to suit a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of engineer/architects and owners, and other information specified.

D. Product Certificates: Signed by manufacturers of through-penetration firestop system products certifying that products furnished comply with requirements.

E. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

F. Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be

required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer's services made necessary to review such additional resubmittals. Owner will in turn reimburse Engineer.

G. Request for Information Requirements:

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems already answered in the project documents.
3. RFI process shall not be used for requesting substitutions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed through-penetration firestop systems 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. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is [UL,] [ITS,] or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:.

    a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:

        1) UL in "Fire Resistance Directory."
        2) ITS in "Directory of Listed Products."

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Meetings."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer; date of manufacture; lot number; shelf life, if applicable; qualified testing and inspecting agency's classification marking applicable to Project; curing time; and mixing instructions for multicomponent materials.

B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated [in the Through-Penetration Firestop System Schedule at the end of Part 3.] [that are available from the following manufacturers:]

B. 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:

1. A/D Fire Protection Systems Inc.
2. DAP Inc.
3. Firestop Systems Inc.
4. Hilti Construction Chemicals, Inc.

5. Instant Firestop Mfg. Inc.
6. International Protective Coatings Corp.
7. Isolatek International.
8. Nelson Firestop Products.
9. NUCO Industries.
10. RectorSeal Corporation (The).
11. Specified Technologies Inc.
12. 3M Fire Protection Products.
13. Tremco.
14. United States Gypsum Company.

2.2 FIRESTOPPING, GENERAL

A. Compatibility: Provide through-penetration firestop systems that are compatible with one another, with the substrates forming openings, and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.

B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by the qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:

1. Permanent forming/damming/backing materials, including the following:

    a. Slag-/rock-wool-fiber insulation.
    b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    c. Fire-rated form board.
    d. Fillers for sealants.

2. Temporary forming materials.
3. Substrate primers.
4. Collars.
5. Steel sleeves.

2.3 MIXING

A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.

B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce through-penetration firestop systems complying with specified requirements.

END OF SECTION 07 84 00

SECTION 07 84 46 - FIRE-RESISTIVE JOINT SYSTEMS

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 fire-resistive joint systems for the following:

1. Floor-to-floor joints.
2. Floor-to-wall joints.
3. Head-of-wall joints.
4. Wall-to-wall joints.

B. Related Sections include the following:

1. Division 07 Section "Penetration Firestopping" for systems installed in openings in walls and floors with and without penetrating items.
2. Division 07 Section "Joint Sealants" for non-fire-resistive joint sealants.

1.3 PERFORMANCE REQUIREMENTS

A. General: For joints in the following constructions, provide fire-resistive joint systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of assembly in which fire-resistive joint systems are installed:

1. Fire-resistance-rated load-bearing walls, including partitions.
2. Fire-resistance-rated non-load-bearing walls, including partitions.
3. Fire-resistance-rated floor assemblies.

B. Fire Resistance of Joint Systems: Assembly ratings and movement capabilities indicated, but with assembly ratings not less than that equaling or exceeding fire-resistance rating of constructions in which joints are located, as determined by UL 2079.

1. Load-bearing capabilities as determined by evaluation during the time test.

1.4 SUBMITTALS

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

B. Shop Drawings: For each fire-resistive joint system, show each kind of construction condition in which joints are installed and relationships to adjoining construction. Include fire-resistive joint system design designation of testing and inspecting agency acceptable to authorities having jurisdiction that demonstrates compliance with requirements for each condition indicated.

1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each fire-resistive joint system configuration for construction and penetrating items.

C. Product Certificates: For each type of fire-resistive joint system, signed by product manufacturer.

D. Qualification Data: For Installer.

E. Evaluation Reports: Evidence of fire-resistive joint systems' compliance with ICBO ES AC30, from the ICBO Evaluation Service.

F. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

G. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fire-resistive joint systems for each kind of joint and construction condition indicated through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide fire-resistive joint systems that comply with the following requirements and those specified in "Performance Requirements" Article:

1. Fire-resistance tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL or another agency performing testing and follow-up inspection services for fire-resistive joint systems acceptable to authorities having jurisdiction.
2. Fire-resistive joint systems are identical to those tested per UL 2079. Provide rated systems complying with the following requirements:

a. Fire-resistive joint system products bear classification marking of qualified testing and inspecting agency.
b. Fire-resistive joint systems correspond to those indicated by referencing system designations listed by the following:

1) UL in its "Fire Resistance Directory."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver fire-resistive joint system products to Project site in original, unopened containers or packages with qualified testing and inspecting agency's classification marking applicable to Project and with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials for fire-resistive joint systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not install fire-resistive joint systems when ambient or substrate temperatures are outside limits permitted by fire-resistive joint system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.

B. Ventilate fire-resistive joint systems per manufacturer's written instructions by natural means or, if this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of joints to ensure that fire-resistive joint systems are installed according to specified requirements.

B. Coordinate sizing of joints to accommodate fire-resistive joint systems.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Basis-of-Design Products: The design for each fire-resistive joint system is based on products named in Part 2 articles. Subject to compliance with requirements, provide either the named products or comparable products by one of the following:

a. Fire-Resistive Joint Systems:

1) A/D Fire Protection Systems Inc.
2) DAP Inc.
3) Firestop Systems Inc.
4) Hilti, Inc.
5) International Protective Coatings Corp.

6) ISOLATEK International.
7) Nelson Firestop Products.
8) NUCO Industries.
9) Pecora Corporation
10) RectorSeal Corporation (The).
11) Specified Technologies Inc.
12) 3M Fire Protection Products.
13) Tremco, Inc.
14) United States Gypsum Company.

2.2 FIRE-RESISTIVE JOINT SYSTEMS, GENERAL

A. Compatibility: Provide fire-resistive joint systems that are compatible with joint substrates, under conditions of service and application, as demonstrated by fire-resistive joint system manufacturer based on testing and field experience.

B. Accessories: Provide components of fire-resistive joint systems, including forming materials, that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by fire-resistive joint system manufacturer and approved by the qualified testing and inspecting agency for systems indicated.

2.3 FIRE-RESISTIVE JOINT SYSTEMS

A. Where UL-classified fire-resistive joint systems are indicated, they refer to alphanumeric designations listed in UL's "Fire Resistance Directory" under product Category XHBN.

B. Floor-to-Floor, Fire-Resistive Joint System FRJS-<#>:

1. Assembly Rating: 2 hours.
2. Nominal Joint Width: As indicated.

C. Floor-to-Wall, Fire-Resistive Joint System FRJS-<#>:

1. Assembly Rating: 2 hours.
2. Nominal Joint Width: As indicated

D. Head-of-Wall, Fire-Resistive Joint System FRJS-<#>:

1. Assembly Rating: 2 hours.
2. Nominal Joint Width: As indicated.

E. Wall-to-Wall, Fire-Resistive Joint System FRJS-<#>:

1. Assembly Rating: 2 hours.
2. Nominal Joint Width: As indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for joint configurations, substrates, and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Clean joints immediately before installing fire-resistive joint systems to comply with fire-resistive joint system manufacturer's written instructions and the following requirements:

1. Remove from surfaces of joint substrates foreign materials that could interfere with adhesion of fill materials.
2. Clean joint substrates to produce clean, sound surfaces capable of developing optimum bond with fill materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Priming: Prime substrates where recommended in writing by fire-resistive joint system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

C. Masking Tape: Use masking tape to prevent fill materials of fire-resistive joint system from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from fire-resistive joint system materials. Remove tape as soon as possible without disturbing fire-resistive joint system's seal with substrates.

3.3 INSTALLATION

A. General: Install fire-resistive joint systems to comply with Part 1 "Performance Requirements" Article and fire-resistive joint system manufacturer's written installation instructions for products and applications indicated.

B. Install forming/packing/backing materials and other accessories of types required to support fill materials during their application and in position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.

C. Install fill materials for fire-resistive joint systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings and forming/packing/backing materials as required to achieve fire-resistance ratings indicated.
2. Apply fill materials so they contact and adhere to substrates formed by joints.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to joints as Work progresses by methods and with cleaning materials that are approved in writing by fire-resistive joint system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure fire-resistive joint systems are without damage or deterioration at time of Substantial Completion. If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated fire-resistive joint systems immediately and install new materials to produce fire-resistive joint systems complying with specified requirements.

END OF SECTION 07 84 46

SECTION 07 92 33 - CONCRETE JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. A single installer shall be responsible for providing complete water proofing system including all products specified in the following Sections:

1. Division 07 Section, “Traffic Coatings”
2. Division 07 Section, “Joint Sealants”
3. Division 07 Section, “Expansion Joint Assemblies”

B. This Section includes the following:

1. Exterior joints in the following horizontal traffic bearing surfaces:

   a. Construction joints in cast-in-place concrete.
   b. Control joints in slab-on-grade, pour strips, slabs and topping slabs.
   c. Perimeter of all floor drains.

2. Exterior joints in the following vertical and horizontal non-traffic surfaces:

   a. Construction joints in cast-in-place concrete.
   b. Cove joints at intersection of horizontal and vertical concrete.
   c. Vertical and horizontal joints between precast beams and columns at tiers exposed directly to weather. Color to match precast concrete.

C. Related Sections: Following Sections contain requirements that relate to this Section.

1. Division 03 Section, "Cast-in-Place Concrete."
2. Division 07 Section, "Firestopping."
3. Division 07 Section, “Traffic Coatings.”
4. Division 07 Section, “Expansion Joint Assemblies.”
5. Division 09 Section, "Pavement Markings."

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Materials shall be compatible with materials or related Work with which they come into contact, and with materials covered by this Section.
2. Distribute reviewed submittals to all others whose Work is related.
3. Coordinate layout of joint system and approve methods for providing joints with precast concrete and concrete contractors.
4. Inspect site and precast plant before precast production to insure proper joint configuration.

B. Make submittals in accordance with requirements of Division 01 Section, “Submittal Procedures:”

1. See requirements of Division 01 Section, “Submittal Procedures,” for limits to resubmittals.
2. See requirements of Division 01 Section, “Submittal Procedures,” for RFI constraints.

C. Submittals and Resubmittals: Engineer will review each of Contractor’s shop drawings and/or submittal data the initial time and, should resubmittal be required, one additional time to verify that reasons for resubmittal have been addressed by Contractor and corrections made. Resubmittal changes/revisions/corrections shall be circled. Engineer will review only circled items and will not be responsible for non-circled changes/revisions/corrections and additions. Should additional resubmittals be required, Contractor shall reimburse Owner for all costs incurred, including the cost of Engineer’s services made necessary to review such additional resubmittals. Owner shall in turn reimburse Engineer.

D. Requests For Information

1. Engineer reserves the right to reject, unprocessed, any Request for Information (RFI) that the Engineer, at its sole discretion, deems frivolous.
2. Engineer reserves the right to reject, unprocessed, any RFI that the Engineer, at its sole discretion, deems already answered in the Contract Documents.
3. RFI process shall not be used for requesting substitutions. Procedures for substitutions are clearly specified elsewhere in the contract documents.

1.4 ACTION SUBMITTALS

A. Product Data: For each system indicated at least 60 days prior to application.

1. Product description, technical data, appropriate applications and limitations.
2. Primer type and application rate

B. Samples:

1. One for each system indicated.

C. Sample Warranty: For each system indicated.

1.5 INFORMATION SUBMITTALS

A. Certificates:

1. Evidence of installer's being certified by manufacturer. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.
2. Certification from the Manufacturer that joint details as specified are acceptable for system to be installed at least 1 month before placement of any concrete which will receive joint sealant.

B. Field Quality Control:

1. Two copies each of manufacturer's technical representative's log for each visit.
2. Testing agency field and test reports.

C. Qualification Statements:

1. Manufacturer's qualifications as defined in the "Quality Assurance" article.
2. Installer's qualifications as defined in the "Quality Assurance" article.
3. Signed statement from this Section applicator certifying that applicator has read, understood, and shall comply with all requirements of this Section.

1.6 CLOSEOUT SUBMITTALS

A. Three copies of System Maintenance Manual.

B. Final executed Warranty.

1.7 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
2. Evidence of financial stability acceptable to Engineer/Architect.
3. Listing of 20 or more projects completed with submitted system, to include:

    a. Name and location of project.
    b. Type of system applied.
    c. On-Site contact with phone number.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and initial stages of installation.

C. Installer's Qualifications: Owner retains right to reject any manufacturer.

1. Evidence of compliance with Summary article paragraph "A single installer. . ."

2. Evidence that installer has successfully performed or has qualified staff who have successfully performed at least 5 verifiable years of installations similar to those involved in this Contract, and minimum 10 projects with submitted system.
3. Listing of 5 or more installations in climate and size similar to this Project performed by installer's superintendent.

D. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

E. Certifications:

1. Licensing/certification document from system manufacturer that confirms system installer is a licensed/certified applicator for the manufacturer and is legally licensed to perform work in the state of California.
2. Licensing/certification agreement shall include following information:

    a. Applicator's financial responsibility for warranty burden under agreement terms.
    b. Manufacturer's financial responsibility for warranty burden under agreement terms.
    c. Process for dispute settlement between manufacturer and applicator in case of system failures where cause is not evident or cannot be assigned.
    d. Authorized signatures for both Applicator Company and Manufacturer.
    e. Commencement date of agreement and expiration date (if applicable).

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.
3. Date of preparation.
4. Lot or batch number.

B. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

C. Do not store material on slabs to be post-tensioned before final post-tensioning of slabs is accomplished. At no time shall weight of stored material being placed on slab area, after post-tensioning is completed and concrete has reached specified 28 day strength, exceed total design load of slab area. Between time final post-tensioning is accomplished and time concrete has reached specified 28 day strength, weight of stored material placed on slab area shall not exceed half total design load of slab area.

1.9 FIELD CONDITIONS

A. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

1.10 WARRANTY

A. System Manufacturer: Furnish Owner with written total responsibility Joint and Several Warranty, detailing responsibilities of manufacturer and installer with regard to warranty requirements (Joint and Several). The warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any adhesive or cohesive failures.
2. Weathering.
3. Abrasion or tear failure resulting from normal traffic use.

B. If material surface shows any of defects listed above, supply labor and material to repair all defective areas and to repaint all damaged line stripes.

C. Warranty period shall be a 5 year Joint and Several Warranty commencing with date of acceptance of work.

D. Perform any repair under this warranty at no cost to Owner.

E. Address the following in the terms of the Warranty: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.

F. Snowplows, vandalism, and abnormally abrasive maintenance equipment are not normal traffic use and are exempted from warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:

1. BASF Building Systems (BASF), Shakopee, MN.
2. Dow Corning Corp. (Dow Corning), Midland, MI.
3. Lymtal International Inc. (Lymtal), Lake Orion, MI.
4. Pecora Corporation (Pecora), Harleysville, PA.
5. Sika Corporation (Sika), North Canton, OH.
6. Sonneborn, a Division of BASF Construction Chemicals (BASF).
7. Tremco (Tremco), Cleveland, OH.

2.2 MATERIALS, JOINT SEALANT SYSTEM

A. Provide complete system of compatible materials designed by manufacturer to produce waterproof, traffic-bearing control joints as detailed on Drawings.

B. Compounds used for sealants shall not stain masonry or concrete. Aluminum pigmented compounds not acceptable.

C. Color of sealants shall match adjacent surfaces.

D. Closed cell or reticulated backer rods: Acceptable products:

1. "Sof Rod," Nomaco Inc., 501 NMC Drive, Zebulon, NC 27597. (800) 345-7279 ext. 341.
2. "ITP Soft Type Backer Rod," Industrial Thermo Polymers Limited, 2316 Delaware Ave., Suite 216, Buffalo, NY 14216. (800) 387-3847.
3. "Sonneborn Soft Type Backer Rod," Sonneborn, Minneapolis, MN.

E. Bond breakers and fillers: as recommended by system manufacturer.

F. Primers: as recommended by sealant manufacturer.

G. Acceptable sealants are listed below. Sealants shall be compatible with all other materials in this Section and related work.

H. Acceptable polyurethane control joint sealants (traffic bearing):

1. Sonolastic SL-2, BASF.
2. Iso-flex 880 GB, Lymtal.
3. Dynatrol II-SG or Urexpan NR 200, Pecora.
4. Sikaflex-2c SL, Sika.
5. THC-900/901, Vulkem 45SSL, or Vulkem 245, Tremco.

I. Acceptable silicone control joint sealants (traffic bearing):

1. Spectrem 800/900SL, Tremco.
2. 310-SL, Pecora.
3. Dow Corning SL or FC Parking Structure Sealant, Dow Corning.

J. Acceptable polyurethane vertical and cove joints sealants (non-traffic bearing):

1. Sikaflex-2c NS, Sika.
2. Sonolastic NP-2, BASF.
3. Dymeric 240/240FC or THC 901 (cove only), Tremco.
4. Dynatred, Pecora.
5. Iso-flex 881, Lymtal.

K. Acceptable silicone vertical and cove joint sealants (non-traffic bearing):

1. Spectrem 1 or Spectrem 4-TS, Tremco.

2. 311-NS, Pecora.
3. Dow Corning NS Parking Structure Sealant, Dow Corning.

L. Proposed Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to receive Work and report immediately in writing to Engineer/Architect any deficiencies in surface which render it unsuitable for proper execution of Work.

B. Coordinate and verify that related Work meets following requirements before beginning installation

1. Concrete surfaces are finished as acceptable for system to be installed.
2. Curing compounds used on concrete surfaces are compatible with system to be installed.
3. Concrete surfaces have completed proper curing period for system selected.

3.2 PREPARATION

A. Seal all openings to occupied space to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

B. Correct unsatisfactory conditions before installing sealant system.

C. Acid etching is prohibited.

D. Grind joint edges smooth and straight with beveled grinding wheel before sealing. All surfaces to receive sealant shall be dry and thoroughly cleaned of all loose particles, laitance, dirt, dust, oil, grease or other foreign matter. Obtain written approval of method from system manufacturer before beginning cleaning.

E. Check preparation of substrate for adhesion of sealant.

F. Prime and seal joints and protect as required until sealant is fully cured. A primer coat is required for all systems.

3.3 INSTALLATION/APPLICATION

A. Do all Work in strict accordance with manufacturer's written instructions and specifications including, but not limited to, moisture content of substrate, atmospheric

conditions (including relative humidity and temperature), thicknesses and texture, and as shown on Drawings.

B. Completely fill joint without sagging or smearing onto adjacent surfaces.

C. Fill horizontal joints slightly recessed to avoid direct contact with wheel traffic.

D. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

E. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

3.4 FIELD QUALITY CONTROL

A. Contractor and Engineer/Architect will jointly determine which one of following 2 methods of sealant testing to verify sealant profile:

1. Contractor, at Engineer/Architect's direction, shall cut out lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.
2. Contractor, at Engineer/Architect's direction, shall install 3 trial joint sections of 20 ft each. Contractor shall cut out joint sections, as selected by Engineer/Architect, for Engineer/Architect and Manufacturer's Representative inspection. Additional isolated/random removals may be required where sealant appears deficient. Total cut out sealant shall not exceed lesser of 1% of total lineal footage placed or total of 100 lineal ft of joint sealant at isolated/random locations (varying from in. to ft of material) for Engineer/Architect and Manufacturer's Representative inspection of sealant profile.

B. Repair all random joint sealant "cut out" sections at no cost to Owner.

C. Testing Agency:

1. Check shore hardness per ASTM standard specified in sealant manufacturer's printed data.
2. If flood test of joints required by this Section, report results to Engineer/Architect.

END OF SECTION 07 92 33

SECTION 07 95 00 - EXPANSION JOINT ASSEMBLIES

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. Expansion joint systems for parking structures:

a. Elastomeric concrete edged, extruded rubber joint system

B. Contractor shall provide in writing the name of the proposed installer, manufacturer, and model of the expansion joint system at the time of bid submittal. See also additional submittal requirements for minimum experience record and qualifications for system. Single licensed installer shall be responsible for providing complete sealant, expansion joint, and waterproofing system designed to minimize occurrence of common sealant, expansion joint, waterproofing, and concrete deterioration problems. All measures called for in these Specifications will be rigorously enforced.

C. Related Sections: The following Sections contain requirements that relate to this section:

1. Division 03 Section "Cast-in-Place Concrete".
2. Division 07 Section "Joint Sealants" for liquid-applied joint sealants.
3. Division 09 Section “Pavement Markings”.

1.3 DEFINITIONS

A. Maximum Joint Width: Widest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

B. Minimum Joint Width: Narrowest linear gap a joint system tolerates and in which it performs its designed function without damaging its functional capabilities.

C. Movement Capability: Value obtained from the difference between widest and narrowest widths of a joint opening typically expressed in numerical values (mm or inches) or a percentage (plus or minus) of nominal value of joint width. Movement capability is to include anticipated movements from concrete shrinkage, concrete shortening and creep from post-tensioning or prestessing, cyclic thermal movements, and seismic movements.

D. Nominal Joint Width: The width of the linear opening specified in practice and in which the joint system is installed.

E. Nominal Form Width: Linear gap in joint system at time of forming or erection of structural elements bounding the expansion joint.

1.4 PREQUALIFICATION OF INSTALLER AND MANUFACTURER

A. Prequalification of Bidders:

1. With Bid, submit evidence of qualifications.
2. Prequalification Criteria, all in writing:

    a. Evidence of compliance with Experience Record and Qualifications paragraph below.
    b. Evidence of acceptable previous work on WALKER-designed projects. If none, so state.
    c. Owner or Engineer/Architect retains absolutely, right to reject any prequalification statement.
    d. Copy of sample warranty.
    e. Evidence of financial stability acceptable to Owner or Engineer/Architect.
    f. Evidence of compliance with "Single Installer" for responsibility of expansion joints, sealants, sealer, and traffic topping.

B. Experience record and qualifications:

1. Manufacturer's and installers experience shall include verification of 5 years experience and 5 verified projects completed with submitted system for similar applications. Verify projects completed with the system identifying the following: Name, date and location of project, system installed, on-site or owner contact and phone number.
2. Information shall be included with bid submission.
3. List Superintendent’s specific training/qualification.
4. Installer/Applicator training and qualification/certification by manufacturer.

C. Sample Labor and Material Warranty including all terms and conditions from manufacturer and installer.

1. Information shall be included with bid submission.
2. See Warranty requirements in Article “Warranty”.

1.5 SUBMITTALS

A. See requirements of Division 01 Section, “Submittal Procedures,” for limits to resubmittals.

B. See requirements of Division 01 Section, “Submittal Procedures,” for RFI constraints.

C. Shop Drawings: Provide the following for each joint system specified:

1. Placement Drawings: Show project conditions including, but not limited to, line diagrams showing plans, elevations, sections, details, splices, blockout requirement, terminations, joint systems change planes, provide isometric or clearly detailed drawing depicting how components interconnect. Include reviewed and approved details from others whose work is related. Other information required to define joint placement or installation.

2. Shop drawings shall include temperature adjustment table with expansion joint opening calculated at 10°F increments. Shop drawing submittal shall show that proposed joint system is of similar configuration, capable of equal individual and combined movements in each direction when installed at designated temperature shown on drawings.

   Where installation temperature is other than specified temperature, submittal shall include calculations showing joint is capable of movement within design temperature range (Criteria on Drawings) for “other” temperature, and that design and installation follow manufacturer’s recommendations.

3. Proposed method of preparation of concrete surface to receive the expansion joint systems. Mockups of the surface preparation may be required for review and to establish a control for the application.
4. Proposed method and details for treatment of cracks, bugholes, or other potential concrete surface defects in areas to receive the expansion joint systems.
5. Other information required to define joint placement or installation, including but not limited to horizontal spacing between embedded metals and plates to allow for volume change due to thermal conditions.
6. Other information required to define joint installation, including but not limited to temperature adjustment table to properly size joint gap at time of concrete pour. Caution, the expansion joint movement capability and the actual joint gap movement may not coincide. Contactor is required to construct actual joint gap in accordance with expansion design criteria.

D. Warranty Requirements: System manufacturer shall submit written plan of the construction and coordination requirements to allow the manufacturer to proceed with installation of joints with the specified warranty. Submit to OWNER for acceptance 2 months prior to ordering materials for construction and specifically address the following:

1. Block out acceptance criteria.
2. Surface preparation acceptance criteria.
3. Crack, surface defect, and detailing recommendations.
4. Method of protection of surrounding surfaces.
5. Method of expansion joint system installation description.
6. Primer type and application rate.
7. Method of preparation of all glands and reinforced membranes.
8. Temperature, humidity and other weather constraints. Specify substrate moisture testing criteria, if any.
9. Final cure time before removal of protection, resumption of traffic, and/or paint striping.
10. Any other special instructions required to ensure proper installation.
11. Quality Service Requirements:

a. Show evidence of licensed/approved installer. List of names, addresses and phone numbers, with copies of certification/approval agreement with each, satisfies requirement. Licensing/certification agreement shall include following information:

1) Installer's financial responsibility for warranty burden under agreement terms.
2) Manufacturer's financial responsibility for warranty burden under agreement terms.
3) Process for dispute settlement between manufacturer and installer in case of system failures where cause is not evident or cannot be assigned.
4) Authorized signatures for both Installer Company and Manufacturer.
5) Commencement date of agreement and expiration date (if applicable).

b. Provide copy of contractor's field application quality control procedures.
c. Installer shall show evidence of minimum 5 projects completed by installer over previous 5 years using submitted system, or similar system.

E. Evidence of manufacturer's certification of installer/applicator. Evidence shall include complete copy of manufacturer's licensing/certification document, spelling out repair responsibility for warranty claims.

F. Signed statement from installer/applicator certifying that installer/applicator has read, understood, and shall comply with all requirements of this Section

G. Signed statement from manufacturer's representative that they have read, understood, and shall comply with all requirements of this section.

H. Two copies each of manufacturer's technical representative's log for each visit.

I. Samples for each type of joint system indicated.

1. Submit 2 samples for each type. Full width by 6 inches (150 mm) long, for each system required.
2. Field samples of premolded joint sealant. Width, thickness and durometer hardness of sealant shall be checked by Testing Agency. Upward buckling caused by joint gap closure shall be limited to a maximum of ¼ inch per ADA Guidelines.

J. Other information required to define joint placement or installation.

K. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for current products.

L. ADA Certification: Prior to installation, submit written certification from manufacturer indicating that expansion joints conform to Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1-800-872-2253.

1. Submit test reports from accredited laboratory attesting to joint systems' movement capability and ADA compliance.
2. Static coefficient of friction shall meet minimum requirements of Americans with Disabilities Act (ADA).

M. Maintenance Manual: Submit 3 copies of System Maintenance Manual.

N. Certification that products and installation comply with applicable federal, state of California, and local EPA, OSHA and VOC requirements regarding health and safety hazards. VOC shall also comply with South Coast Air Quality Management in southern California (SCAQMD) Rule 1113.

1.6 MAINTENANCE PROGRAM

A. Provide separate line item bid price for 5 year maintenance program for the vehicle rated seismic expansion joint system. The Maintenance Program includes observations, reports, and maintenance of all components for seismic expansion joint system, including such items as cover plates, bolts, centering bars, springs, noise dampeners, extrusions, header material, and waterproofing membranes are to be covered by the agreement.

1.7 QUALITY ASSURANCE

A. Testing Agency: Independent testing laboratory employed by Owner and acceptable to Engineer/Architect.

B. Installer Qualifications: An employer of workers trained and approved by manufacturer.

C. Source Limitations: A single Installer shall be responsible for providing complete expansion joint system. Obtain joint systems through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of joint systems and are schematic for systems indicated in Part 2.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

2. Refer to Division 01 Section "Product Requirements."

E. Walking Surfaces: Expansion joint assemblies at walking areas subject to pedestrian traffic shall provide a smooth, slip resistant walking surface for pedestrians with these minimum requirements:

1. Shall provide walking surfaces in accordance with ASTM – F 1637 Standard Practice for Safe Walking Surfaces.

2. Shall be designed to comply with “Americans with Disabilities Act (ADA), Accessibility Guidelines (ADAAG)” and ICC A117.1. Americans with Disabilities Accessibility Guidelines for Buildings and Facilities, as published by U.S. Architectural & Transportation Barriers Compliance Board, 1331 F Street, N.W., Suite 1000, Washington, DC 20004-1111. 1–800-872-2253.
3. Adjoining walkway surfaces shall be flush and meet the following minimum requirements:

    a. Changes in level of less than ¼ inch in height may be without edge treatment as shown in ADA Figure 303.2 and on the Drawings.
    b. Changes in Level between ¼ inch and ½ inch in height shall be beveled with a slope no greater than 1:2 as shown in ADA Figure 303.3 and on the Drawings.
    c. Changes in level grater than ½ inch in height are not permitted unless they can be transitioned by means of a ramp as shown on Drawings.
    d. Openings in floor or ground surfaces shall not allow passage of a sphere more than ½ inch diameter except as allowed for elevators and platform lifts as shown in ADA Figure 302.3 and on the Drawings.

F. Materials shall be compatible with materials or related Work with which they come into contact and the related materials sections.

G. Manufacturer/Applicator: Review and approve all details before construction. Confirm in writing to OWNER.

H. Installer: Coordinate services with related Work including layout of joint system and approval of methods for providing joints.

I. Installer: Inspect site to insure proper joint configuration in field.

J. Testing Agency shall check Shore A hardness of materials in accordance with ASTM D2240 and ensure the limited upward buckling of ¼ inch or less.

K. Pre-installation Conference: Meet at project site well in advance of time scheduled for Work to proceed to review requirements for Work and conditions that could interfere with successful expansion joint system performance. Require every party concerned with concrete formwork, blockout, concrete placement, or others required to coordinate or protect the Work thereafter, to attend. Include manufacturer's technical representative and warranty officer.

L. Manufacturer: Provide qualified technical representative for periodic inspection of Work at critical time of the installation, including but not limited to pre-concrete formwork and placement site meetings, block out inspection, surface defect repair, surface preparation, metal work, expansion gland installation and waterproofing system installation.

M. Deliver all materials to site in original, unopened containers, bearing following information:

1. Name of product.
2. Name of manufacturer.

3. Date of preparation.
4. Lot or batch number.

N. Store materials under cover and protect from weather. Replace packages or materials showing any signs of damage with new material at no additional cost to Owner.

O. Weather and Substrate Conditions: Proceed with work only when existing and forecast weather and temperature of concrete substrate will permit work in accordance with manufacturer's recommendations.

P. Provide reports to owner detailing maintenance activities have been performed in accordance with written maintenance agreement for expansion joints.

1.8 COORDINATION

A. Coordinate construction of the concrete joint openings and block outs. Provide expansion joint system requirements for concrete joint openings, configuration, and surfaces accepting expansion joint materials. Provide requirements for joint opening width, transitions, tolerances, level, plum, and to ensure the installed expansion joint system can perform with expected movement capabilities.

B. Expansion joint blockouts shall be floated and troweled before final cure to remove all air pockets, voids and spalls caused by form work. Blockouts shall be plumb with maximum tolerance of Manufacturer or not more than 0.125 inches deviation in 12 inches. Blockouts shall be straight and true with maximum tolerance of Manufacturer or not more than 0.250 inches deviation in 10 lineal feet. Noncompliant blockouts will be considered major defects. Refer to Items below.

C. Expansion joint surface areas each side of joint gap shall be finish graded perpendicular to joint gap creating flush slab-to-slab transition for a minimum of three feet. Elevations on each side shall have a vertical differential less than ¼” and meet requirements of expansion joint manufacturer.

D. Minor surface defects shall be repaired according to manufacturer’s recommendations. Repair materials shall be compatible to intended system materials and shall be approved by the Engineer prior to surface preparation and installation.

E. All major defects shall be submitted for project approvals. The CONTRACTOR shall provide repair products and methods of repair. Repair description shall indicate materials, manufacturer’s requirements, expected service life, and maintenance requirements. Repair description shall be submitted for project approvals. All repairs of slab and blockout surfaces shall be repaired by contractor. CONTRACTOR to take all precautions necessary to avoid damaging adjacent surfaces and embedded reinforcement or post tensioned anchors and tendons. CONTRACTOR is responsible for any damages. Concrete repairs shall be of rectangular configuration, with no feather-edged surfaces. Final surface preparation of all repairs shall be sandblasting, or approved equal.

1.9 WARRANTY

A. Warranty period shall be a 5 year labor and materials warranty commencing with date of acceptance of work.

1. Warranty shall be jointly executed by Manufacturer and Installer for labor and materials.
2. With bid submittal, provide Owner with sample of final labor and materials warranty including, but not limited, to the following: length of warranty, change in value of warranty – if any- based on length of remaining warranty period, transferability of warranty, responsibilities of each party, notification procedures, dispute resolution procedures, and limitations of liability for direct and consequential damages.
3. With bid submittal, provide the Owner with sample of Manufacturer's Licensing/Certification Agreement, detailing joint responsibilities of manufacturer and applicator with regard to warranty claim resolution.

B. Perform any repair under this warranty at no cost to Owner.

C. Expansion Joint Systems Manufacturer: Furnish OWNER with written Warranty detailing responsibilities of General Contractor, manufacturer and installer with regard to warranty requirements, as outlined in the Manufacturer's warranty and related Licensing/Certification documents. Submit a copy of the warranty and related documents and/or Licensing/Certification Agreement. The warranty shall provide that system will be free of defects, water penetration and chemical damage related to system design, workmanship or material deficiency, consisting of:

1. Any water leakage through the expansion joint system or leaking conditions of the reinforced membrane, other waterproofing components, or glands.
2. Any adhesive or cohesive failures of the system.
3. Shifting of plates out of alignment due to system failure.
4. Loose plates, anchor blocks, bolts.
5. Metal to metal noises during use.
6. Tears, weathering, or degradation in gland from normal use.
7. Expansion joint glands are considered defective if they buckle upwards beyond the level of the floor surface after installation.

D. If expansion joint systems or components show any of defects listed above, supply labor and material to repair all defects at no cost to OWNER.

1. Components of the systems include the following:

a. Extrusions
b. Elastomeric header material

1.10 PERFORMANCE AND DESIGN CRITERIA

A. Contractor shall provide engineering for the expansion joint for preparation of final details for fabrication and construction of all concrete openings, expansion joint

elements and required accessories. An integral part of this project is engineering for the following:

1. Include engineering calculations for the size and forming of the concrete openings to provide the nominal joint width as indicated on the drawings. Provide a summary of the design criteria used in the design.
2. Include engineering calculations for the appropriate size of the expansion joint elements in accordance with the expansion joint assembly performance criteria. Include the installation requirements of the expansion joint assembly for specific project conditions and scheduling. Provide a summary of the design criteria used in the design.
3. Analysis shall be performed by a licensed professional engineer in the State of California indicating joint system complies with criteria and requirements of this specification and is suitable for use in conditions of this project.
4. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Engineer/Architect.

B. Contractor shall provide structural engineering of the expansion joint assembly and required accessories. An integral part of this project is engineering for final details, calculations and shop drawings as required for the performance and design criteria and shall include, as a minimum, the following:

1. Submit analysis performed by a licensed professional engineer in the State of California indicating expansion joint system complies with expansion joint performance and design criteria of this specification and is suitable for use in conditions of this project. Provide a summary of the design criteria used in the design.
2. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect.

C. Expansion Joint Assembly Performance and Design Criteria: provide the following minimum requirements:

1. Expansion joint design shall meet or exceed all of the expected movements shown on the drawings.
2. Installation temperature range and estimated volume change movements are shown on the drawings. The nominal form width shown on the drawings shall be adjusted for the ambient temperature at the time of installation and the designer shall verify that the width of the joint at installation shall meet the minimum installation requirements.
3. Expansion joint systems shall be capable of resisting a differential vertical movement of ½ inch.
4. Materials shall be supplied in lengths to minimize or eliminate the need to splice the waterproofing components.

    a. Materials shall be supplied with no joints in the vehicle drive aisles and with lengths no shorter than 20 feet.
    b. All mitered splices shall be performed at the factory and provide sufficient gland length for butt splicing with field splicing equipment.

c. All Santoprene butt to butt splices shall be heat welded.
d. Butt to butt splices with other materials shall be per manufacturer's recommendations.

5. Expansion joint assemblies subject to vehicular traffic shall be designed for vehicular loading, including vertical wheel load and associated lateral thrust generated by passing vehicular traffic in drive aisles, but not less than the following:

a. For passenger vehicle loading a minimum design vertical concentrated wheel load of 3000 pounds.
b. Minimum additional vertical load factor of 1.3 shall be used to allow for dynamic, vibratory, and impact effects.
c. Minimum horizontal force of fifty percent of the maximum vertical wheel load shall be applied in combination with vertical loads to account for vehicle de-acceleration and acceleration effects.
d. System shall be designed for passenger vehicles traveling at low sustained speeds in a garage.
e. System shall be designed for passenger vehicles traveling at street and highway speeds (sustained speeds of 30 mph or higher).
f. Cast aluminum or stainless steel centering bars with allowance to rotate on ends and centering bolt connection with coil spring tensioners or torque installed bolts per manufacturer design. Centering bar spacing shall be as required for the manufacturer's system design, but no greater than 18 inches on center.
g. Impact sound dampeners, internally mounted on plate or encapsulating plate. Shore hardness of 70 according to ASTM Standards. There shall be no metal impact noises during vehicular movement.
h. Seismic slide plate expansion joint systems shall be designed such that plate remains in service during and after a seismic event.
i. Seismic slide plate system shall remain within the elastic range under all loading conditions listed above and shall return to original position without residual deformation or deflection.

6. Walking Surfaces as specified in Article "Quality Assurance" Paragraph E "Walking Surfaces".

D. Shop drawings shall include temperature adjustment table with expansion joint opening calculated at increments as indicated in Article "Submittals".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of 1 of following, only where specifically named in product category:
1. Construction Specialties, Inc., Muncy, PA (C/S).
2. Emseal Joint Systems, Westborough, MA (Emseal).
3. Lymtal International Inc. Lake Orion, MI (Lymtal).

4. MM Systems Corporation, Atlanta, GA (MM).
5. Watson Bowman Acme Corporation, a Division of BASF Construction Chemicals NA, Amherst, NY (WBA).

2.2 MATERIALS, EXPANSION JOINT SYSTEMS

A. General:

1. Material shall be applied in lengths to minimize or eliminate the need to splice the waterproofing components.
2. Materials shall meet requirements in specification Article “Performance and Design Criteria”, specification paragraph “Expansion Joint Assembly Performance and Design Criteria”.
3. Materials installed in surfaces with pedestrian traffic shall conform to requirements for walking surfaces in Article “Performance and Design Criteria”.

B. Elastomeric concrete edged, extruded rubber expansion joint system where shown. Acceptable systems:

1. C/S Elastomeric Membrane/Nosing System, Model WF or C/S Zip Block System, Model ZB, C/S.
2. IsoFlex Elastomeric Membrane/Nosing System, DuraBlock, LymTal.
3. Lokcrete Membrane System (LMS) Series, MM.
4. Wabo®Crete II Membrane 201 System, WBA.
5. Thermaflex Membrane/Nosing System, Type TM and TCR Series, Emseal.

C. Substitutions: **None** for this project. Contact Engineer/Architect for consideration for future projects.

2.3 PRODUCTS, OTHER

A. Fire rated joint sealing systems: See Section "Fire Resistive Joint Systems."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces and blockouts where expansion joint systems will be installed for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to joint system manufacturer's written instructions.

B. Repair concrete slabs and blockouts using manufacturer's recommended repair grout of compressive strength adequate for anticipated structural loadings.

C. Coordinate and furnish anchorages, setting drawings, and instructions for installing joint systems. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of joint systems.

D. Coordinate and verify that related Work meets following requirements:

1. Concrete surfaces are finished as acceptable for system to be installed.
2. Check adhesion to substrates and recommend appropriate preparatory measures.
3. Curing compounds used on concrete surfaces are compatible with Work to be installed.
4. Concrete surfaces have completed proper curing period for system selected.
5. Coordinate expansion joint system with other related Work before installation of expansion joint.
6. Verify expansion joints are compatible with Joint Sealants and traffic toppings.

E. Acid etching: Prohibited.

F. All openings to occupied space shall be sealed to prevent cleaning materials, solvents and fumes from infiltration. All protective measures and/or ventilating systems required to prevent infiltration are incidental to this Work.

G. General Contractor: Correct unsatisfactory conditions in manner acceptable to installer before installing sealant system. All bugholes and air voids in blockouts shall be patched as acceptable to Engineer/Architect prior to installation of Expansion Joint Sealant system.

1. Proceed with expansion joint system only after unsatisfactory conditions have been corrected in manner acceptable to installer.

H. Clean joints thoroughly in accordance with manufacturer's instructions to remove all laitance, unsound concrete and curing compounds which may interfere with adhesion.

I. Cease installation of expansion joints under adverse weather conditions, or when temperatures are outside manufacturer's recommended limitations for installation.

J. Prepare for installation of extruded expansion joint systems in accordance with manufacturer's recommendations.

K. Cease installation if expansion joint blockouts and/or openings exhibit cracked edges, voids or spalls. Repair with accepted material prior to installation of expansion joint.

L. Check elevations on each side of expansion joint gap utilizing metal straight edge to ensure flush slab-to-slab transition. Recommend remedial correction.

M. Check anticipated or actual minimum and maximum joint openings with Engineer. Compare to manufacturer’s movement specifications and make joint sizing recommendations.

3.3 INSTALLATION

A. Comply with manufacturer's written instructions for storing, handling, and installing joint assemblies and materials unless more stringent requirements are indicated.

B. Manufacturer's technical representative, acceptable to Engineer/Architect, shall be on site during surface preparation and installation.

C. Cease material installation under adverse weather conditions, or when temperatures are outside manufacturers recommended limitations for installation, or when temperature of work area or substrate are below 40ºF.

D. During months when historic mean daily temperature at Project is 20° F. or more colder than annual mean daily temperature, premolded sealant shall be installed on temporary basis to prevent hot weather buckling. Provide permanent installation during acceptable weather conditions.

E. Terminate exposed ends of joint assemblies with field- or factory-fabricated termination devices.

F. In-place testing: Prior to opening to traffic, test joint seal for leaks with maintained continuously wet for 12 hours. Repair leaks revealed by examination of seal underside. Repeat test and repairs until all leaks stopped for full 12 hours.

3.4 PROTECTION

A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.

B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over joints. Reinstall cover plates or seals prior to Substantial Completion of the Work.

3.5 CLEANING

A. Clean off excess material and material smears adjacent to joints as work progresses using methods and materials approved by manufacturers.

END OF SECTION 07 95 00

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 SUMMARY

A. Section Includes:

1. Standard hollow metal doors and frames.

B. Related Sections:

1. Division 04 Section "Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
2. Division 08 Section "Door Hardware" for door hardware for hollow metal doors.
3. Division 09 Sections "Exterior Painting" for field painting hollow metal doors and frames.

1.3 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

C. Custom Hollow Metal Work: Hollow metal work fabricated according to ANSI/NAAMM-HMMA 861.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, fire-resistance rating and finishes.

B. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.

3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of each different wall opening condition.
6. Details of anchorages, joints, field splices, and connections.
7. Details of accessories.
8. Details of moldings, removable stops, and glazing.
9. Details of conduit and preparations for power, signal, and control systems.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification:

1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
2. For the following items, prepared on Samples about 12 by 12 inches (305 by 305 mm to demonstrate compliance with requirements for quality of materials and construction:

   a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
   b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.

E. Other Action Submittals:

1. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

F. Oversize Construction Certification: For assemblies required to be fire rated and exceeding limitations of labeled assemblies.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing according to NFPA 252.

1. Temperature-Rise Limit: At vertical exit enclosures, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

C. Preinstallation Conference: Conduct conference at Project site.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to finish of factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch-(102-mm-) high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Deansteel Manufacturing Company, Inc.
6. Firedoor Corporation.
7. Fleming Door Products Ltd.; an Assa Abloy Group company.
8. Habersham Metal Products Company.
9. Karpen Steel Custom Doors & Frames.

10. Kewanee Corporation (The).
11. Mesker Door Inc.
12. Pioneer Industries, Inc.
13. Security Metal Products Corp.
14. Steelcraft; an Ingersoll-Rand company.
15. Windsor Republic Doors.
16. Approved product similar in design, construction, and performance.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. (96- to 192-kg/cu. m) density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Division 08 Section "Glazing."

J. 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.

2.3 STANDARD HOLLOW METAL 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/SDI A250.8.

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.
3. Vertical Edges for Single-Acting Doors: Square edge.
4. Verify availability of door edge in first subparagraph below with standard door manufacturers. This profile is not recognized in ANSI/SDI A250.8 and may not be available from all manufacturers.
5. 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.
6. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."

B. Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Level 3 and Physical Performance Level A (Extra Heavy Duty), Model 2 (Seamless).

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Frames: Fabricated from metallic-coated steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as face welded unless otherwise indicated.
3. Frames for Level 3 Steel Doors: 0.053-inch- (1.3-mm-) thick steel sheet.

C. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2. 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.

2.6 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 hollow metal frames, a minimum of 5/8 inch (16 mm) 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.

2.7 LOUVERS

A. Provide louvers for doors, where indicated, that comply with SDI 111C, with blades or baffles formed of 0.020-inch- ((0.5-mm-)) thick, cold-rolled steel sheet set into 0.032-inch- (0.8-mm-) thick steel frame.

1. Sightproof Louver: Stationary louvers constructed with inverted V-shaped or Y-shaped blades.
2. Lightproof Louver: Stationary louvers constructed with baffles to prevent light from passing from one side to the other, any angle.
3. Fire-Rated Automatic Louvers: Louvers constructed with movable blades closed by actuating fusible link, and listed and labeled for use in fire-rated door

assemblies of type and fire-resistance rating indicated by same testing and inspecting agency that established fire-resistance rating of door assembly.

2.8 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

2.9 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

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.

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.
2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

    a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:

        1) Two anchors per jamb up to 60 inches (1524 mm) high.
        2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
        3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.

    b. Compression Type: Not less than two anchors in each jamb.

c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.

E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.

F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.

G. 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.

2.10 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

B. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI/SDI A250.3 for performance and acceptance criteria.

2.11 Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:

1. 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.
2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
3. 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.
4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI 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. At fire-protection-rated openings, install frames according to NFPA 80.
    b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    c. Install frames with removable glazing stops located on secure side of opening.
    d. Install door silencers in frames before grouting.
    e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled 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. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
5. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
6. Installation Tolerances: Adjust hollow metal 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.

C. Hollow Metal 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 (1.6 mm).
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).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (50 mm) o.c. from each corner.

3.4 ADJUSTING AND CLEANING

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 hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 11 13

SECTION 08 41 13

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior elevator framing.

B. Related Sections:
1. Division 08 Section "Louvers And Vents" for units installed with aluminum-framed systems.

1.3 DEFINITIONS

A. ADA/ABA Accessibility Guidelines: U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disability Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities."

1.4 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Glazing-to-glazing contact.

e. Noise or vibration created by wind and by thermal and structural movements.
f. Loosening or weakening of fasteners, attachments, and other components.
g. Sealant failure.
h. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Structural Loads:

1. Wind Loads: As designed by Engineer of record to comply with Building codes

a. Basic Wind Speed: 70 mph
b. Importance Factor: 1.0
c. Exposure Category: C

2. Seismic Loads: In accordance to applicable codes
a. At any floor, maximum seismic displacement for floor will occur while floor immediately aboe and below remain in undisplaced condition
1) Glazing gaskets may not disengage
2) Weather seals may not fail

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components directly below them to less than 1/8 inch (3.2 mm) and clearance between members and operable units directly below them to less than 1/16 inch (1.5 mm)]

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, systems do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not fewer than 10 seconds.

F. Story Drift: Provide aluminum-framed systems that accommodate design displacement of adjacent stories indicated.

1. Test Performance: Meet criteria for passing, based on building occupancy type, when tested according to AAMA 501.4 at design displacement[
2. ASTM E 283 requires using a static-air-pressure difference of 1.57 lbf/sq. ft. (75 Pa) unless otherwise indicated, which is equivalent to a 25-mph (40-km/h) wind. Static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa) is equivalent to a 50-mph (80-km/h) wind.

G. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. (0.03 L/s per sq. m) of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa) For water-penetration tests, static-air-pressure difference of 20 percent of wind-load design pressure provides satisfactory performance in most parts of the U.S. Locations where high winds and heavy rains frequently occur simultaneously require higher test-pressure differences. Lower test-pressure differences are acceptable for some locations. Revise first paragraph below to suit Project.

H. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) Retain paragraph above for static-pressure test method, which is most frequently specified, or first paragraph below for dynamic-pressure test method. Both static-pressure and dynamic-pressure testing may be required; however, most manufacturers do not include test data in product literature for dynamic-pressure method.

I. Water Penetration under Dynamic Pressure: Provide aluminum-framed systems that do not evidence water leakage through fixed glazing and framing areas when tested according to AAMA 501.1 under dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa) AAMA 501.1's definition of water leakage allows up to 1/2 oz. (15 mL) of water to accumulate in a 15-minute period on an interior stop or stool integral to system.

1. Maximum Water Leakage: According to AAMA 501.1 Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

J. Thermal Movements: Provide aluminum-framed systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. 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 (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
2. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5.

    a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of [180 deg F (82 deg C)]
    b. Low Exterior Ambient-Air Temperature: [0 deg F (minus 18 deg C)]

3. Interior Ambient-Air Temperature: [75 deg F (24 deg C)]

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for aluminum-framed systems.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
2. For entrance doors, include hardware schedule and indicate operating hardware types, functions, quantities, and locations.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

E. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12-inch (300-mm) lengths of full-size components and showing details of the following:

1. Joinery, including concealed welds.
2. Anchorage.
3. Expansion provisions.
4. Glazing.
5. Flashing and drainage.

F. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

G. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Detail fabrication and assembly of aluminum-framed systems.
2. Include design calculations.

H. Qualification Data: For qualified Installer

I. Seismic Qualification Certificates: For aluminum-framed systems, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

J. Welding certificates.

K. Preconstruction Test Reports: For sealant.

L. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for aluminum-framed systems, indicating compliance with performance requirements.

M. Source quality-control reports.

N. Quality-Control Program for Structural-Sealant-Glazed System: Include reports.

O. Field quality-control reports.

P. Maintenance Data: For aluminum-framed systems to include in maintenance manuals.

Q. Warranties: Sample of special warranties.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Quality-Control Program for Structural-Sealant-Glazed System: Develop quality control program specifically for Project. Document quality-control procedures and verify results for aluminum-framed systems. Comply with ASTM C 1401 recommendations including, but not limited to, system material-qualification procedures, preconstruction sealant-testing program, procedures for system fabrication and installation, and intervals of reviews and checks.

E. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

1. Do not revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review.

F. Preconstruction Sealant Testing: For structural-sealant-glazed systems, perform sealant manufacturer's standard tests for compatibility with and adhesion of each material that will come in contact with sealants and each condition required by aluminum-framed systems.

1. Test a minimum five samples each of metal, glazing, and other material.
2. Prepare samples using techniques and primers required for installed systems.
3. For materials that fail tests, determine corrective measures necessary to prepare each material to ensure compatibility with and adhesion of sealants including, but not limited to, specially formulated primers. After performing these corrective measures on the minimum number of samples required for each material, retest materials.

G. Accessible Entrances: Comply with applicable provisions in California Building Code.

H. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

I. Structural-Sealant Glazing: Comply with ASTM C 1401, "Guide for Structural Sealant Glazing" for design and installation of structural-sealant-glazed systems.

J. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

K. Welding Qualifications: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

L. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.

1. Build mockup of typical wall area as shown on Drawings.
2. Field testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

M. Preinstallation Conference: Conduct conference at Project site

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Structural failures including, but not limited to, excessive deflection.
b. Noise or vibration caused by thermal movements.
c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
d. Adhesive or cohesive sealant failures.
e. Water leakage through fixed glazing and framing areas.
f. Failure of operating components.

2. Warranty Period: five years from date of Substantial Completion.

B. 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 or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Basis of Design Kawneer Trifab VG 450 Inside Glazed
2. Arcadia, Inc.
3. EFCO Corporation.
4. United States Aluminum.
5. Vistawall Architectural Products; The Vistawall Group; a Bluescope Steel company.
6. Approved product similar in design, construction, and performance.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.

5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Nonthermal
2. Glazing System: Retained mechanically with gaskets on four sides
3. Glazing Plane: As indicated

B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads[, finished to match framing system

D. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

E. Concealed Flashing: [Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials]

F. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:

1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.

a. Color: Matching structural sealant.

2.5 ACCESSORY MATERIALS

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Division 07 Section "Joint Sealants."

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.6 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
4. Physical and thermal isolation of glazing from framing members.
5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
6. Provisions for field replacement of glazing from exterior
7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Storefront Framing: Fabricate components for assembly using shear-block system or screw-spline system.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.7 ALUMINUM FINISHES

A. High-Performance Organic Finish: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than [70] percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

2. Dry Film Thickness
   a. Coil: .80 mil
   b. Extrusion: 1.0 mil

3. Acceptable Coatings Manufacturers:
   a. Akzo Nobel Coatings, Inc., Columbus, OH.
   b. Lilly Industries, Inc., Indianapolis, IN.
   c. Morton International, Inc., Chicago, IL.
   d. PPG Industries, Inc., Pittsburgh, PA.
   e. Valspar Corporation, Minneapolis, MN.
   f. Approved product similar in design, construction, and performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 08 Section "Glazing."

1. Structural-Sealant Glazing:

a. Prepare surfaces that will contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
b. Install weatherseal sealant according to Division 07 Section "Joint Sealants" and according to sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind sealant as recommended by sealant manufacturer.

G. Install perimeter joint sealants as specified in Division 07 Section "Joint Sealants" to produce weathertight installation.

3.3 ERECTION TOLERANCES

A. Install aluminum-framed systems to comply with the following maximum erection tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 20 feet (3 mm in 3.7 m); 1/4 inch (6 mm) over total length.
2. Alignment:

a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch (1.5 mm).
b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch (0.8 mm).

B. Diagonal Measurements: Limit difference between diagonal measurements to 1/8 inch (3 mm).

3.4 FIELD QUALITY CONTROL

A. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.5 ADJUSTING

A. Adjust operating entrance door hardware to function smoothly as recommended by manufacturer.

1. For entrance doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches (75 mm) from the latch, measured to the leading door edge.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes items known commercially as finish or door hardware that are required for swing, except special types of unique hardware specified in the same Sections as doors and door frames on which they are installed.

B. Related Sections: Following Sections contain requirements that relate to this Section:

1. Division 08 Section "Hollow Metal Doors and Frames" for silencers integral with hollow metal frames.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product data including 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.

C. Final hardware schedule coordinated with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. 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:

a. Type, style, function, size, and finish of each hardware item.
b. Name and manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of each hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
e. Explanation of all abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for hardware.
g. Door and frame sizes and materials.

D. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

E. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.4 QUALITY ASSURANCE

A. Single Source Responsibility: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer.

B. Supplier Qualifications: Recognized architectural door hardware supplier, with warehousing facilities in the Project's vicinity, that has a record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that employs an experienced architectural hardware consultant (AHC) who is available to Owner, Engineer/Architect, and Contractor, at reasonable times during the course of the Work, for consultation.

1. Require supplier to meet with Owner to finalize keying requirements and to obtain final instructions in writing.

C. Regulatory Requirements: Comply with provisions of the following:

1. All hardware shall comply with accessibility requirements. Use the most restrictive standards of the following codes. “Accessibility Guidelines for Buildings and Facilities (ADAAG),” or Local Accessibility Standards as required by the Governing Body.

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. Must operate with a closed fist.
b. Door Closers: Comply with the following maximum opening-force requirements indicated:

1) Interior Hinged Doors: 5 lbf applied perpendicular to door..
2) Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

c. Thresholds: [Not more than ½ inch high] [Not more than ¾ inch high for exterior sliding doors]. Bevel raised thresholds with a slope of not more than 1:2.
d. Provide knurled levers at doors to elevator equipment room, machine room and other hazardous areas.

2. NFPA 101: Comply with the following for means of egress doors:

a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.

b. Door Closers: Not more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
c. Thresholds: Not more than ½ inch high.

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 items of door hardware that are listed and 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.

1.5 PRODUCT HANDLING

A. Inventory door hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

B. Deliver individually packaged door hardware items promptly to place of installation (shop or Project site).

1.6 MAINTENANCE

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by 1 of the following:

1. Butts and Hinges:

a. Hager Hinge Co.
b. McKinney Products Co.
c. H. Soss & Company.
d. Stanley Hardware, Div. Stanley Works.
e. Approved product similar in design, construction, and performance.

2. Pivots:

a. Sargent Manufacturing Co.
b. Hager Hinge Co.
c. LCN, Div. Ingersoll-Rand Door Hardware Group.
d. Norton Door Controls, Div. Yale Security Inc.
e. Rixson-Firemark, Div. Yale Security Inc.

f. Stanley Hardware, Div. Stanley Works.
g. Approved product similar in design, construction, and performance.

3. Key Control System:

a. Key Control Systems, Inc.
b. Telkee Inc.
c. Sargent Manufacturing Co.
d. Approved product similar in design, construction, and performance.

4. Cylinders and Locks:

a. Best Lock Corp.
b. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
c. Falcon Lock Co.
d. Sargent Manufacturing Company.
e. Schlage Lock, Div. Ingersoll-Rand Door Hardware Group.
f. Yale Security Inc.
g. Approved product similar in design, construction, and performance.

5. Bolts:

a. Builders Brass Works Corp.
b. Glynn-Johnson Corp.
c. Hager Hinge Co.
d. H. B. Ives, A Harrow Company.
e. Quality Hardware Mfg. Co., Inc.; Div. Newman Tonks, Inc.
f. Stanley Hardware, Div. Stanley Works.
g. Approved product similar in design, construction, and performance.

6. Exit/Panic Devices:

a. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
b. Precision Hardware, Inc.
c. Sargent Manufacturing Co.
d. Von Duprin, Div. Ingersoll-Rand Door Hardware Group.
e. Yale Security Inc
f. Approved product similar in design, construction, and performance.

7. Push/Pull Units:

a. Baldwin Hardware Corp.
b. Brookline Industries, Div. Yale Security Inc.
c. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
d. Hager Hinge Co.
e. Hiawatha, Inc.
f. H. B. Ives, A Harrow Company.
g. Triangle Brass Manufacturing Company (Trimco).
h. Approved product similar in design, construction, and performance.

8. Overhead Closers:

a. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
b. Dorma Door Controls International.
c. LCN, Div. Ingersoll-Rand Door Hardware Group.
d. Norton Door Controls, Div. Yale Security Inc.
e. Rixson-Firemark, Div. Yale Security Inc.
f. Sargent Manufacturing Co.
g. Yale Security Inc.
h. Approved product similar in design, construction, and performance.

9. Smoke-Activated Closers:

a. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
b. Dor-O-Matic.
c. Dorma Door Controls International.
d. Norton Door Controls, Div. Yale Security Inc.
e. Rixson-Firemark, Div. Yale Security Inc.
f. Yale Security Inc.
g. Sargent Manufacturing Co.
h. Approved product similar in design, construction, and performance.

10. Door Control Devices:

a. Baldwin Hardware Corp.
b. Brookline Industries, Div. Yale Security Inc.
c. Builders Brass Works Corp.
d. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
e. Glynn-Johnson Corp.
f. Hager Hinge Co.
g. H. B. Ives, A Harrow Company.
h. Quality Hardware Mfg. Co., Inc.; Div. Newman Tonks, Inc.
i. Triangle Brass Manufacturing Company (Trimco).
j. Sargent Manufacturing Co.
k. Approved product similar in design, construction, and performance.

11. Door Trim Units:

a. Baldwin Hardware Corp.
b. Brookline Industries, Div. Yale Security Inc.
c. Builders Brass Works Corp.
d. Hager Hinge Co.
e. H. B. Ives, A Harrow Company.
f. Triangle Brass Manufacturing Company (Trimco).
g. Approved product similar in design, construction, and performance.

12. Kick, Mop, and Armor Plates:

a. Baldwin Hardware Corp.
b. Brookline Industries, Div. Yale Security Inc.
c. Corbin & Russwin Architectural Hardware, Div. Black & Decker Corp.
d. Hager Hinge Co.
e. Hiawatha, Inc.

f. H. B. Ives, A Harrow Company.
g. Triangle Brass Manufacturing Company (Trimco).
h. Approved product similar in design, construction, and performance.

13. Door Stripping and Seals:

a. Hager Hinge Co.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co., Inc.
d. Reese Enterprises, Inc.
e. Sealeze Corp.
f. Ultra Industries.
g. Zero International, Inc.
h. Approved product similar in design, construction, and performance.

14. Thresholds:

a. Hager Hinge Co.
b. National Guard Products, Inc.
c. Pemko Manufacturing Co., Inc.
d. Reese Enterprises, Inc.
e. Sealeze Corp.
f. Zero International, Inc.
g. Approved product similar in design, construction, and performance.

2.2 MATERIALS AND FABRICATION

A. Base Metals: Produce hardware units of basic metal and forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness, but in no case of lesser (commercially recognized) quality than specified for applicable hardware units by applicable ANSI/BHMA A156 series standards for each type of hardware item and with ANSI/BHMA A156.18 for finish designations indicated. Do not furnish "optional" materials or forming methods for those indicated, except as otherwise specified.

B. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware that has been prepared for self-tapping sheet metal screws, except as specifically indicated.

C. Furnish screws for installation with each hardware item. Provide Phillips flat-head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of this other work as closely as possible including "prepared for paint" surfaces to receive painted finish.

2.3 HINGES, BUTTS, AND PIVOTS

A. Screws: Provide Phillips flat-head screws complying with the following requirements:

1. For metal doors and frames install machine screws into drilled and tapped holes.
2. Finish screw heads to match surface of hinges or pivots.

B. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:

1. Out-Swing Exterior Doors: Nonremovable pins.
2. Out-Swing Corridor Doors with Locks: Nonremovable pins.
3. Interior Doors: Nonrising pins.

C. Number of Hinges: Provide number of hinges indicated but not less than 3 hinges per door leaf for doors 90 in. or less in height and 1 additional hinge for each 30 in. of additional height.

1. Fire-Rated Doors: Not less than 3 hinges per door leaf for doors 86 in. or less in height with same rule for additional hinges.

2.4 LOCK CYLINDERS AND KEYING

A. Review keying system with the Owner and provide the type required (master, grandmaster or great-grandmaster), either new or integrated with Owner's existing system.

B. Equip locks with manufacturer's standard 6-pin tumbler cylinders.

C. Metals: Construct lock cylinder parts from brass or bronze, stainless steel, or nickel silver.

D. Comply with Owner'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.

1. Permanently inscribe each key with number of lock that identifies cylinder manufacturer's key symbol, and notation "DO NOT DUPLICATE."

E. Key Material: Provide keys of nickel silver only.

F. Key Quantity: Furnish 3 change keys for each lock, 5 master keys for each master system, and 5 grandmaster keys for each grandmaster system.

1. Deliver keys to Owner.

2.5 LOCKS, LATCHES, AND BOLTS

A. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame, finished to match hardware set, unless otherwise indicated.

1. Provide flat lip strikes for locks with 3-piece, antifriction latchbolts as recommended by manufacturer.

2. Provide recess type top strikes for bolts locking into head frames, unless otherwise indicated.
3. Provide dust-proof strikes for foot bolts, except where special threshold construction provides nonrecessed strike for bolt.
4. Provide roller type strikes where recommended by manufacturer of the latch and lock units.

B. Lock Throw: Provide 0.625-in. minimum throw of latch on pairs of doors. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.

1. Provide 0.5-in. minimum throw of latch for other bored and preassembled types of locks and 0.75-in. minimum throw of latch for mortise locks. Provide 1-in. minimum throw for all dead bolts.

C. Flush Bolt Heads: Minimum of 0.5-in.-diameter rods of brass, bronze, or stainless steel with minimum 12-in.-long rod for doors up to 7 ft in height. Provide longer rods as necessary for doors exceeding 7 ft in height.

2.6 PUSH/PULL UNITS

A. Exposed Fasteners: Provide manufacturer's standard exposed fasteners for installation, thru-bolted for matched pairs but not for single units.

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 parallel arms for all overhead closers, except as otherwise indicated.

B. Access-Free Manual Closers: Where manual closers are indicated for doors required to be accessible to the physically handicapped, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.

C. Provide black resilient parts for exposed bumpers.

2.8 DOOR TRIM UNITS

A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units consisting of either machine screws or self-tapping screws.

B. Fabricate edge trim of stainless steel to fit door thickness in standard lengths or to match height of protection plates.

C. Fabricate protection plates not more than 1.5 in. less than door width on hinge side and not more than 0.5 in. less than door width on pull side by height indicated.

1. Metal Plates: Stainless steel, 0.050 in. (U.S. 18 gage).

2.9 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 noncorrosive 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: Provide bumper-type resilient insert and metal retainer strips, surface applied unless shown as mortised or semimortised, and of following metal, finish, and resilient bumper material:

1. Extruded aluminum with natural anodized finish, 0.062-in. minimum thickness of main walls and flanges.

D. Weatherstripping at Door Bottoms: Provide threshold consisting of contact-type resilient insert and metal housing of design and size shown and of following metal, finish, and resilient seal strip:

1. Extruded aluminum with natural anodized finish, 0.062-in. minimum thickness of main walls and flanges.

2.10 THRESHOLDS

A. General: Except as otherwise indicated, provide standard metal threshold unit of type, size, and profile as shown or scheduled.

1. For out-swinging doors provide rabbeted type units with replaceable weatherstrip insert in stop.

2.11 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 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.

C. Provide protective lacquer coating on all exposed hardware finishes of brass, bronze, and aluminum, except as otherwise indicated.

D. Designations used in schedules and elsewhere to indicate hardware finishes are the industry-recognized standard commercial finishes, except as otherwise noted.

1. Rust-Resistant Finish: For iron and steel base metal required for exterior work and in areas shown as "High Humidity" areas (and also when designed with the suffix -RR), provide 0.2-mil-thick copper coating on base metal before applying brass, bronze, nickel, or chromium plated finishes.

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 Engineer/Architect.

1. "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute.

B. Install each hardware item in compliance with 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 specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on the substrates involved.

C. Set units level, plumb, and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.

E. Set thresholds for exterior doors in full bed of butyl-rubber or polyisobutylene mastic sealant complying with requirements specified in Division 07 Section "Joint Sealers."

F. Weatherstripping and Seals: Comply with manufacturer's instructions and recommendations to the extent installation requirements are not otherwise indicated.

3.2 ADJUSTING, CLEANING, AND DEMONSTRATING

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.

1. Where door hardware is installed more than 1 month prior to acceptance or occupancy of a space or area, return to the installation during the wk prior to acceptance or occupancy and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.

B. Clean adjacent surfaces soiled by hardware installation.

END OF SECTION 08 71 00

SECTION 08 90 00

LOUVERS AND VENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed, formed-metal acoustical louvers.

B. Related Sections:

1. Division 08 Section "Hollow Metal Doors and Frames" for louvers in hollow-metal doors.
2. Division 09 Section "Exterior Painting" for field painting louvers.
3. Division 23 Sections for louvers that are a part of mechanical equipment.

1.3 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.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural[and seismic] performance requirements and design criteria indicated.

B. Structural Performance: Louvers 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.
2. Wind Loads: Determine loads based on a uniform pressure of30 lbf/sq. ft. (1436 Pa)] acting inward or outward.

C. Seismic Performance: Louvers, including attachments to other construction, shall withstand the effects of earthquake motions determined according to [SEI/ASCE 7]

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.

1. Temperature Change (Range): [120 deg F (67 deg C), ambient; material surfaces.

E. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

F. Acoustic Performance: Provide acoustical louvers complying with ratings specified, as demonstrated by testing manufacturer's stock units identical to those specified, except for length and width for [] [outdoor-indoor sound-transmission loss according to ASTM E 966].

1.5 SUBMITTALS

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

1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.

B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.

1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
2. Show mullion profiles and locations.
3. Wiring Diagrams: For power, signal, and control wiring for motorized adjustable louvers.

C. Delegated-Design Submittal: For louvers indicated to comply with structural[and seismic] performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain louvers and vents from single 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 D1.2/D1.2M, "Structural Welding Code - Aluminum."
2. AWS D1.3, "Structural Welding Code - Sheet Steel."
3. 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.

D. UL and NEMA Compliance: Provide motors and related components for motor-operated louvers that are listed and labeled by UL and comply with applicable NEMA standards.

1.7 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication and indicate measurements on Shop Drawings..

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.

B. Galvanized-Steel Sheet: ASTM A 653/A 653M, [G60 zinc coating, mill phosphatized.

C. Fasteners: Use types and sizes to suit unit installation conditions.

1. Use Phillips screws for exposed fasteners unless otherwise indicated.
2. Use type and sizes to suit unit installation conditions.

D. Post installed 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 E 488, conducted by a qualified independent testing agency.

E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

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. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

1. Continuous Vertical Assemblies: Fabricate units without interrupting blade-spacing pattern.
2. Horizontal Mullions: Provide horizontal mullions at joints.

C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Exterior flange unless otherwise indicated.

E. Include supports, anchorages, and accessories required for complete assembly.

F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or 72 inches (1830 mm) o.c., whichever is less.

1. Exposed Mullions: Where indicated, provide units with exposed mullions of same width and depth as louver frame. Where length of louver exceeds fabrication and handling limitations, provide interlocking split mullions designed to permit expansion and contraction.

G. Provide [subsills made of same material as louvers] [or] [extended sills] for recessed louvers.

H. Join frame members to each other and to fixed louver blades with fillet welds concealed from view unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.3 FIXED, FORMED METAL LOUVERS

A. Horizontal Storm-Resistant Louver

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. Air Balance Inc.; a Mestek company.
b. Air Flow Company, Inc.

c. Airolite Company, LLC (The).
d. All-Lite Architectural Products.
e. American Warming and Ventilating, Inc.; a Mestek company.
f. Arrow United Industries; a division of Mestek, Inc.
g. Construction Specialties, Inc.
h. Greenheck Fan Corporation.
i. Industrial Louvers, Inc.
j. NCA Manufacturing, Inc.
k. Nystrom Building Products.
l. Reliable Products, Inc.
m. Ruskin Company; Tomkins PLC.
n. United Enertech Corp.
o. Approved product similar in design, construction, and performance.

2. Louver Depth: 4 inches (100 mm).
3. Frame and Blade Nominal Thickness: Not less than [0.080 inch (2.03 mm)] Louver Performance Ratings:

a. Free Area: Not less than 50% free area.
b. Air Performance: Not more than 0.10-inch wg (25-Pa) static pressure drop at 600-fpm (3.0-m/s) free-area exhaust or intake velocity.
c. Wind-Driven Rain Performance: Not less than 80 percent effectiveness when subjected to a rainfall rate of 3 inches (75 mm) per hour and a wind speed of 29 mph (13 m/s).

2.4 LOUVER SCREENS

A. General: Provide screen at each exterior louvers.

1. Screen Location for Fixed Louvers: Interior face.
2. Screening Type: Bird screening.

B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of 6 inches (150 mm) from each corner and at 12 inches (300 mm) o.c.

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: Same finish as louver frames to which louver screens are attached.

D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.

2.5 FINISHES, GENERAL

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

2.6 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 A 780.

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: As selected by Architect from manufacturer's full range]

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. 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.

F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Test operation of adjustable louvers and adjust as needed to produce fully functioning units that comply with requirements.

B. 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 during construction period.

C. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

D. 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 Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 90 00

SECTION 09 29 00 - GYPSUM BOARD

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. Interior gypsum wallboard.
2. Exterior gypsum board panels for ceilings and soffits.
3. Non-load-bearing steel framing.

B. Division 09 Section "Painting" for painting of exterior gypsum board

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 SUBMITTALS

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

B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.

C. Samples: For the following products:

1. Trim Accessories: Full-size sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

D. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

E. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance-Rated Assemblies: Indicated by design designations from FM's "Approval Guide, Building Products."

B. Gypsum Board Finish Mockups: Before finishing gypsum board assemblies, install mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and qualities of materials and execution.

1. Install mockups for the following applications:

a. Surfaces with texture finishes.
b. Surfaces indicated to receive nontextured paint finishes.
c. Surfaces indicated to receive textured paint finishes.

2. Simulate finished lighting conditions for review of mockups.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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. Steel Framing and Furring:

    a. Clark Steel Framing Systems.
    b. Consolidated Systems, Inc.
    c. Dale Industries, Inc. - Dale/Incor.
    d. Dietrich Industries, Inc.
    e. MarinoWare; Division of Ware Ind.
    f. National Gypsum Company.
    g. Scafco Corporation.
    h. Unimast, Inc.
    i. Western Metal Lath & Steel Framing Systems.

2. Gypsum Board and Related Products:

    a. American Gypsum Co.
    b. G-P Gypsum Corp.
    c. National Gypsum Company.
    d. United States Gypsum Co.

2.2 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with ASTM A 653/A 653M, G40 (Z120), hot-dip galvanized zinc coating.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: As indicated.
2. Depth: As indicated.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges.

D. Proprietary Deflection Track: Steel sheet top runner manufactured to prevent cracking of gypsum board applied to interior partitions resulting from deflection of structure above; in thickness indicated for studs and in width to accommodate depth of studs.

1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Product: Subject to compliance with requirements, provide one of the following:

    a. Delta Star, Inc., Superior Metal Trim; Superior Flex Track System (SFT).
    b. Metal-Lite, Inc.; Slotted Track.

E. Proprietary Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

1. Available Product: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
2. Product: Subject to compliance with requirements, provide one of the following:

    a. Fire Trak Corp.; Fire Trak attached to studs with Fire Trak Slip Clip.
    b. Metal-Lite, Inc.; The System.

F. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base Metal Thickness: As indicated.

G. Cold-Rolled Channel Bridging: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange.

1. Depth: As indicated.
2. Clip Angle: 1-1/2 by 1-1/2 inch (38.1 by 38.1 mm), 0.068-inch- (1.73-mm-) thick, galvanized steel.

H. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: As indicated.
2. Depth: As indicated.

I. Resilient Furring Channels: 1/2-inch- (12.7-mm-) deep, steel sheet members designed to reduce sound transmission.

1. Configuration: Asymmetrical or hat shaped, with face attached to single flange by a slotted leg (web) or attached to two flanges by slotted or expanded metal legs.

J. Cold-Rolled Furring Channels: 0.0538-inch (1.37-mm) bare steel thickness, with minimum 1/2-inch- (12.7-mm-) wide flange.

1. Depth: As indicated.
2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum bare steel thickness of 0.0312 inch (0.79 mm).
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch- (1.59-mm-) diameter wire, or double strand of 0.0475-inch- (1.21-mm-) diameter wire.

K. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (31.8 mm), wall attachment flange of 7/8 inch (22.2 mm), minimum bare metal thickness of 0.0179 inch (0.45 mm), and depth required to fit insulation thickness indicated.

L. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.3 EXTERIOR GYPSUM BOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Exterior Gypsum Soffit Board: ASTM C 931/C 931M, with manufacturer's standard edges.

1. Core: 5/8 inch (15.9 mm), Type X.

A. Glass-Mat Gypsum Sheathing Board: ASTM C 1177/C 1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.

1. Available Product: Subject to compliance with requirements, a product that may be incorporated into the Work includes, but is not limited to, "Dens-Glass Gold" by G-P Gypsum Corp.
1. Approved product similar in design, construction, and performance.
2. Core: 5/8 inch (15.9 mm), Type X.

2.4 TRIM ACCESSORIES

A. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead: Use at outside corners.
b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening. Use where indicated.

2.5 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Exterior Gypsum Soffit Board: Paper.
3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.

C. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping and setting-type, sandable topping compounds.
2. Glass-Mat Gypsum Sheathing Board: As recommended by manufacturer.

2.6 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

D. Polyethylene Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

2.7 TEXTURE FINISHES

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

B. Primer: As recommended by textured finish manufacturer.

C. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.

1. Texture: Sand Finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet

accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

a. Use deep-leg deflection track where indicated.
b. Use proprietary deflection track where indicated.
c. Use proprietary firestop track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.3 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at infill, and structural walls and columns where gypsum board assemblies abut other construction.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For fire-resistance-rated partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

a. Terminate partition framing at suspended ceilings where indicated.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. Screw vertical studs

at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Install two studs at each jamb, unless otherwise indicated.
2. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint.
3. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

H. Z-Furring Members:

1. Erect insulation vertically and hold in place with Z-furring members spaced 24 inches (610 mm).
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (600 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (300 mm) from corner and cut insulation to fit.
4. Until gypsum board is installed, hold insulation in place with 10-inch (250-mm) staples fabricated from 0.0625-inch- (1.59-mm-) diameter, tie wire and inserted through slot in web of member.

I. Polyethylene Vapor Retarder: Install to comply with requirements specified in Division 07 Section "Thermal Insulation."

3.4 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

C. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

D. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

E. Attach gypsum panels to framing provided at openings and cutouts.

F. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.

G. Form control and expansion joints with space between edges of adjoining gypsum panels.

H. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

I. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

J. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

3.5 PANEL APPLICATION METHODS

A. Single-Layer Application:

1. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

2. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.

B. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring

member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

1. Z-Furring Members: Apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.

C. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

D. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.6 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

3.8 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.

B. Texture Finish Application: Mix and apply finish using powered spray equipment, to produce a uniform texture matching approved mockup and free of starved spots or other evidence of thin application or of application patterns.

C. Prevent texture finishes from coming into contact with surfaces not indicated to receive texture finish by covering them with masking agents, polyethylene film, or other means. If, despite these precautions, texture finishes contact these surfaces, immediately remove droppings and overspray to prevent damage according to texture finish manufacturer's written recommendations.

END OF SECTION 09 29 00

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 SUMMARY

A. This Section includes surface preparation and field painting or staining of the following:

1. Exposed items and surfaces.
2. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
3. Surface preparation, priming, and anti-graffiti coatings.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Engineer will select from standard colors and finishes available.

1. Painting includes field painting of 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.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:

a. Elevator entrance doors and frames.
b. Elevator equipment: coordinate with elevator contractor to ensure avoid elevator operational problems caused by painting elevator items that should not be painted.
c. Finished mechanical and electrical equipment.
d. Light fixtures.
e. Distribution cabinets.

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:

a. Furred areas.

b. Ceiling plenums.
c. Utility tunnels.
d. Pipe spaces.
e. Duct shafts.
f. Elevator shafts

3. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel.

4. Operating parts include moving parts of operating equipment and the following:

a. Valve and damper operators.
b. Linkages.
c. Sensing devices.
d. Motor and fan shafts.

5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

D. Related Sections include the following:

1. Division 05 Section "Structural Steel Framing" for shop priming structural steel.
2. Division 05 Section "Metal Fabrications" for shop priming ferrous metal.
3. Division 08 Section "Hollow Metal Doors and Frames" for shop priming steel doors and frames.
4. Division 09 Section "Pavement Markings" for traffic-marking paint.
5. Division 09 Section " Gypsum Board" for painting of exterior gypsum board.

1.3 DEFINITIONS

A. Standard terms used by the coatings industry are defined in ASTM d 16.

B. General: Standard coating terms defined in ASTM D 16 apply to this Section.

1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85° meter.
2. Semigloss refers to medium-sheen finish with a gloss range between 30 and 65 when measured at a 60° meter.
3. Full gloss refers to high-sheen finish with a gloss range more than 65 when measured at a 60° meter.

1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

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 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).

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

1. After color selection, the Engineer/Architect will furnish color chips for surfaces to be coated.

C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.

1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
2. Provide a list of materials and applications for each coat of each sample. Label each sample for location and application.
3. Submit Samples on the following substrates for Engineer/Architect’s review of color and texture only:

    a. Concrete and Concrete Masonry Units: Provide 2 4-in.- sq samples for each color and finish.
    b. Exterior Gypsum Board: Provide 2 4-in.- sq samples for each color and finish.
    c. Ferrous Metal: Provide 2 4-in.- sq samples of flat metal and 2 8-in.- long samples of solid metal for each color and finish.

D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of Engineer and Owners, and other information specified.

E. See requirements of Division 01 Section, “Submittal Procedures,” Part 1 heading, “Submittal Procedures,” for limits to resubmittals.

F. See requirements of Division 01 Section, “Submittal Procedures,” Part 2 heading, “Requests for Information,” for RFI constraints.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project Site in 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.
8. VOC content.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45° F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

1. 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.

1.7 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90° F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95° F.

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85%; or at temperatures less than 5° F above the dew point; or to damp or wet surfaces.

1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

1.8 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to the Owner.

1. Quantity: Furnish the Owner with extra paint materials in the quantities indicated below:

    a. Flat Acrylic Paint: 1 case of each color applied.
    b. Semigloss Acrylic Enamel: 2 gal. of each color applied.
    c. Full-Gloss Alkyd Enamel: 2 gal. of each color applied.

2. Quantity: Furnish the Owner with an additional 5%, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide 1 of the products in the paint schedules.

B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses.

1. ICI Paints (www.icipaintstores.com) (ICI).
2. Benjamin Moore & Co. – (www.benjaminmoore.com) (Moore).
3. Pittsburgh Paints (www.pittsburghpaints.com) (PPG).
4. Pratt & Lambert Paints (www.prattandlambert.com) (P&L).
5. Sherwin-Williams Co. - (www.sherwin-willams.com) (S-W).

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with 1 another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

C. Colors: Provide color selections made by Engineer/Architect.

2.3 ANTI-GRAFITTI COATINGS

A. Base Coat:
   1. Sherman Williams – Loxon Conditioner, A24-100 Series
   2. Approved product similar in design, construction, and performance.

B. Finish Coat:
   1. Genesis Coatings, Inc. – GCP 1000 (Aliphatic Polyurethane Top Coat)
   2. Approved product similar in design, construction, and performance.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.

   1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

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.

   1. Notify Engineer/Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

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 before cleaning.

   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete, concrete masonry block, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

    a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
    b. 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 written instructions.

3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.

    a. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

D. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.

4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
5. 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.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.

B. Scheduling Painting: 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.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces 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.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. 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.

F. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

G. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 ANTI-GRAFITTI COATINGS

A. Apply Loxon Conditioner as per manufacturer's recommendations to all exterior columns, walls, and doors up to a minimum of 10 feet above finished grade. Do not apply to glass surfaces.

B. Apply Loxon Conditioner as per manufacturer's recommendations to all interior columns, walls, and doors up to a minimum of 10 feet above finished floor. Do not apply to glass surfaces.

C. Apply Anti-Grafitti Top Coat as per manufacturer's recommendations within 7 days of applying Loxon conditioner..

3.5 CLEANING

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. 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.

2. After completing anti-grafitti coating, follow manufacture's recommendations for clean up procedures.

3.6 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 approved by 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.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.7 PAINT SCHEDULE

A. Concrete and Masonry (Other than Concrete Masonry Units): Provide the following finish systems over concrete and masonry surfaces:

1. Flat Acrylic Finish: 2 finish coats over a primer.

a. Primer: Alkali-resistant, exterior, acrylic-latex primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.5 mils.

1) ICI: 2000 Prep and Prime House Acrylic Primer.
2) Moore: Benjamin Moore 066 Acrylic Masonry Sealer.
3) PPG: 4-603 Perma Crete Interior/Exterior Acrylic Latex Alkali Resistant Primer.
4) P & L: Primer not required over this substrate.
5) SW: Loxon Acrylic Primer A24W300.

b. First and Second Coats: Flat, exterior, acrylic-emulsion paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.4 mils.

1) ICI: 2200 Dulux Professional Acrylic Flat.
2) Moore: Super Spec Flat 189.
3) PPG: 72 Line Sun-Proof Exterior Flat Latex House Paint.
4) P & L: Z/F 1900 Series RedSeal Flat House Paint.

B. Concrete Masonry Units: Provide the following finish systems over concrete masonry units:

1. Flat Acrylic Finish: 2 finish coats over a block filler.

a. Block Filler: High-performance, latex block filler applied at spreading rate recommended by the manufacturer to achieve a total dry mill thickness of not less than 4.0 mils.

1) ICI: 3010 Prep and Prime Latex Block Filler.
2) Moore: Super Craft Block Filler #285.
3) P & L: Z/F8465 enducryl Heavy Duty Latex Block Filler.
4) SW: Loxon Block Surfacer A24W200.

b. First and Second Coats: Flat, exterior, acrylic-emulsion paint applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.4 mils.

1) ICI: 2200 Dulux Professional Acrylic Flat.

2) Moore: Super Spec Flat 189.
3) PPG: 72 Line Sun-Proof Exterior Flat Latex House Paint.
4) P & L: Z/F 1900 Series RedSeal Flat House Paint.
5) SW: A-100 Exterior Flat Latex Paint A6 Series.

C. Ferrous Metal: Provide the following finish systems over ferrous metal. Primer is not required on shop-primed items.

1. Full-Gloss, Acrylic-Enamel Finish: 2 finish coats over a rust-inhibitive primer.

a. Primer: Rust-inhibitive metal primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.3 mils.

1) ICI: 4020 DevFlex DTM Waterborne Primer.
2) Moore: M04 Acrylic Metal Primer.
3) PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.
4) P&L: Steeltech S5791Interior/Exterior Rust Inhibitive Steel Primer.
5) S-W: Pro-Cryl Universal Metal Primer B66-310 Series.

b. First and Second Coats: Full-gloss, waterborne, acrylic enamel applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.4 mils.

1) ICI: 3038 Ultra Hide Durus Acrylic Gloss Enamel.
2) Moore: M28 Acrylic Gloss Enamel.
3) PPG: 90 Line Pitt-Tech 1 Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels.
4) P&L: Z/F Z6600 Series Enducryl Acrylic Maintenance Enamel.
5) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series.

END OF SECTION 09 91 00

SECTION 09 91 20 - PAVEMENT MARKING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Contract 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 surface preparation and application of paint systems for the high build, two coat systems for the items of types, patterns, sizes, and colors described in this article.

B. Provide the following systems as shown on Drawings:

1. Parking Stall Stripes.
2. Traffic Arrows, crosswalks, accessible stall access aisles, walkways, symbols, stop bars, words and other markings.
3. International Symbol of Accessibility.

C. International Symbol of Accessibility proportions shall be as shown in ANSI A117.1-1992 and Americans with Disabilities Act (ADA) Accessibility Guidelines - 1991.

D. Related Work:

1. Pavement Marking Contractor shall verify compatibility with joint sealants, caulking and all other surface treatments as specified in Division 07.

1.3 SUBMITTALS

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

B. Provide product data as follows:

1. Manufacturer’s certification that the material complies with:

   a. Federal specifications where required in this Section.
   b. Acceptance by State and/or Local DOT for use on roads in vicinity of project where not required to meet a Federal Specification herein.

2. Intended paint use.
3. Pigment type and content.
4. Vehicle type and content.

C. Submit list of similar projects (minimum of 5) where pavement-marking paint has been in use for a period of not less than 2 yrs.

D. See requirements of Division 01 Section, “Submittal Procedures,” for limits to resubmittals.

E. See requirements of Division 01 Section, “Submittal Procedures,” for RFI constraints.

1.4 PROJECT CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

1.5 QUALITY ASSURANCE

A. Provide written 1 year warranty to Owner that pavement markings will be free of defects due to workmanship, inadequate surface preparation, and materials including, but not limited to, fading and/or loss of markings due to abrasion, peeling, bubbling and/or delamination. Excessive delamination, peeling, bubbling or abrasion loss shall be defined as more than 15% loss of marking material within one year of substantial completion and/or occupancy of the parking area. With no additional cost to Owner, repair and/or recoat all pavement marking where defects develop or appear during warranty period and all damage to other Work due to such defects.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Pavement marking materials shall meet Federal, State and Local environmental standards.

B. Paint shall be manufactured and formulated from first grade raw materials and shall be free from defects or imperfections that might adversely affect product serviceability.

C. Paints shall comply with the National Organic Compound Emission Standards for Architectural Coatings, Environmental Protection Agency, 40 CFR Part 59 (1998).

D. The product shall not contain mercury, lead, hexavalent chromium, or halogenated solvents.

E. Pavement marking materials shall have a static coefficient of friction equal to 0.8 for markings on accessible ramps, curbs and curb ramps and a static coefficient of friction equal to 0.6 for all other markings. Silica sand and/or glass beads may be used to

achieve the required coefficient of friction, in accordance with manufacturer's recommendations.

2.2 ACCEPTABLE PAVEMENT MARKING PAINTS:

A. Water-borne 100% acrylic paint shall be used for white and yellow pavement markings and shall meet requirements of Federal Specification TT-P-1952E.

1. All latex paint products shall have performance requirements of Type I and II of Federal Standard TT-P-1952E.
2. Water-borne paint for special color pavement markings (blue, green, red, black) shall meet requirements of Federal Specification TT-P-1952E. Special color marking materials shall be compatible with the white and yellow pavement markings where they are layered.
3. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

    a. Setfast Acrylic Waterborne Traffic Marking Paint, TM 226, TM 227; by Sherwin Williams Company.
    b. Setfast Low VOC Acrylic Traffic Marking Paint, TM 5626, TM 5627; by Sherwin Williams Company.

2.3 COLOR OF PAINT

A. Color of paint, unless noted otherwise on Contract Drawings, shall be yellow and shall match federal color chip No. 33538. Color shall have daylight directional reflectance (without glass beads) of not less than 50% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

B. Paint color for blue accessible parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 35180. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

C. Paint color for green special-use parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 34108. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

D. Paint color for red special-use parking space pavement markings, if shown on Contract Drawings, shall match federal color chip No. 31136. Color shall have daylight directional reflectance (without glass beads) of not less than 52% (relative to magnesium oxide) when tested in accordance with Federal Test Method Standard 141, Method 6121.

E. Paint color for black special-use pavement markings, if shown on Contract Drawings, shall match federal color chip No. 37038. Black paint shall also meet Federal Specification TT-P-110.

2.4 BEADS

A. Beads (Glass Spheres) may be used in all pavement markings except stall striping lines and shall conform to Federal Specification TT-B-1325, Type I. Beads shall be mixed with paint prior to application at rate not less than 6 lbs per gallon of paint. Broadcast of beads after application of paint will not be accepted. Test for bead adhesion shall be conducted in accordance with Federal Specification TT-P-850 Section 4.3.6 excepting Section 4.3.6.2.

2.5 SILICA SAND

A. Silica Sand, where used, shall be foundry grade silica sand composed of at least 99.5 percent silicon dioxide when tested in accordance with ASTM C 146. The gradation of silica sand shall meet the paint manufacturer's recommendation. Silica sand shall be applied at rate not less than 4 lbs per gallon of paint. Sand shall be mixed with paint prior to application at rate not less than 6 lbs per gallon of paint. Broadcast of sand after application of paint will not be accepted.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

D. Striping shall not be placed until full cure of concrete slab and sealer. Concrete surfaces generally require 30 to 90 days @ 70°F or higher. Sealers (other than silane) generally require 14 days @ 70°F or higher. Silane sealers require 24 hrs @ 70°F or higher. Bituminous surfaces generally require 30 days @ 45° F or higher.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Do not paint or finish any surface that is wet or damp.

C. Clean substrates of substances that could impair bond of paints, including dirt, dust, oil, grease, and incompatible paints and encapsulants.

D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.

E. Lay out all striping on each tier, using dimensions and details shown on Contract Drawings, before painting that tier. Report any discrepancies, interferences or changes in striping due to field conditions to Engineer/Architect prior to painting. Pavement Marking Contractor shall be required to remove paint, repair surface treatment and repaint stripes not applied in strict accordance with Contract Drawings.

F. Work Areas:

1. Store, mix and prepare paints only in areas designated by Contractor for that purpose.
2. Provide clean cans and buckets required for mixing paints and for receiving rags and other waste materials associated with painting. Clean buckets regularly. At close of each day's Work, remove used rags and other waste materials associated with painting.
3. Take precautions to prevent fire in or around painting materials. Provide and maintain appropriate hand fire extinguisher near paint storage and mixing area.

G. Mixing:

1. Do not intermix materials of different character or different manufacturer.
2. Do not thin material except as recommended by manufacturer.

H. Disposal:

1. Contractor shall properly dispose of unused materials and containers in compliance with Federal Resource Conservation Recovery Act (RCRA) of 1976 as amended, and all other applicable laws and regulations.

3.3 APPLICATION

A. Apply paint in 2-coat system; first coat shall be 50% of total 15 wet mil minimum thickness, not to exceed 8 mils. First coat shall be cured prior to installation of second coat. At Contractor’s option, one coat may be applied before substantial completion, with a second coat delayed for 3-6 months until weather conditions are appropriate and the concrete has cured sufficiently for proper adhesion.

1. Two coat system total wet mil thickness of 0.015 in (0.381 mm).

2. Two coat system total wet mil thickness of 0.018 to 0.025 in (0.457 – 0.635 mm) When Type IVA beads are used.
3. Two coat system total wet mil thickness of 0.015 to 0.018 in (0.381 – 0.457 mm) When Type IVB beads are used.

B. Apply painting and finishing materials in accordance with manufacturer's directions. Use applications and techniques best suited for material and surfaces to which applied. Minimum air shall be used to prevent overspray. Temperature during application shall be minimum of 40º F and rising, unless manufacturer requires higher minimum temperature. Maximum relative humidity shall be as required by manufacturer.

C. Application of beads and/or silica sand shall coincide with application of paint, but shall be done as separate operation by a suitable dispenser. Sand may be premixed with paint for application to curbs only. Glass beads and silica sand shall adhere to the cured paint or all marking operations shall cease until corrections are made.

D. All lines shall be straight, true, and sharp without fuzzy edges, overspray or non-uniform application. Corners shall be at right angles, unless shown otherwise, with no overlaps. Line width shall be uniform (-0%, +5% from specified width). No excessive humping (more material in middle than at edges or vice versa).

END OF SECTION 09 91 20

SECTION 101400 – SIGNAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes following types of signs:

1. Reflective vehicular directional and information signs (V- Signs).
2. Reflective regulatory signs (R- Signs).
3. Non-reflective pedestrian directional and informational signs (PP- Signs).
4. PVC Pipe Clearance Signs (PVC- Signs).
5. Vandal-resistant Signs (VR- Signs).
6. Brailled ADA Compliant Identification Signs (A-Signs).
7. Dimensional Characters (D-Signs).
8. Exterior non-illuminated panel signs (EP- Signs).
9. Internally-Illuminated Signs (I- Signs).

B. Related Sections include following:

1. Division 01 Section “Temporary Facilities” for temporary project identification signs.
2. Division 09 Section “Painting” for painting by others of surfaces to which signs specified herein may be applied. Painting of signs is included in this Section.
3. Division 11 Section “Parking Access and Revenue Controls” for occupancy counting systems which interface with space availability displays as specified herein.
4. Division 14 Section “Elevators” for elevator door jamb markings.
5. Division 23 Section “Mechanical Identification” for labels, tags, and nameplates for mechanical equipment. (Room designation signage is included herein.)
6. Division 26 Section “Electrical Identification” for labels, tags, and nameplates for electrical equipment. (Room destination signage is included herein.)
7. Division 26 Section “Interior Lighting” for illuminated exit signs.
8. See Division 26 Sections for electrical service and connections for electrified and/or illuminated signs and/or letters.

1.3 SUBMITTALS

A. General: Submit following in accordance with Conditions of Contract and Division 01 Specification Sections.

B. Product Data: Include manufacturer's construction details relative to materials, dimensions of individual components, profiles, and finishes for each type of sign required.

C. Shop Drawings: Provide shop drawings for fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, mounting heights, anchors, grounds, reinforcement, accessories, layout, spacing, dimensions and installation details.

1. Provide message list for each sign required, including large-scale details of wording, artwork as shown on drawings, and layout of lettering.
2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
3. Wiring Diagrams from manufacturer of electrified signs.

D. Samples: Provide following samples of each sign component for verification of compliance with requirements indicated.

1. Samples of each sign type (V-, R-, PP-, VR-, etc), on not less than 6-in. squares of extrusion, sheet or plate, showing full range of colors to be provided.
2. Dimensional characters and castings: Full size sample showing character, material, texture, finish, color, style and attachment method.
3. Brailled Copy: Sample of ADA compliant sign showing raised image text, brailled copy and colors.

E. Maintenance Data: For signage cleaning and maintenance requirements to be included in maintenance manual.

F. See requirements of Division 01 Section "Submittal Procedures" Part 1 heading "Submittal Procedures" for limits to re-submittals.

G. See requirements of Division 01 Section "Submittal Procedures" Part 2 heading "Requests for Information" for RFI procedures.

1.4 QUALITY ASSURANCE

A. Qualifications: Manufacturers: Only pre-approved manufacturers as listed herein allowed. Sign manufacturer shall have completed a minimum of 3 projects in last 3 years with similar materials and methods of manufacture as required for this project.

B. Where warranties are required, manufacturer and/or installers shall be authorized by the entity providing the warranty.

C. All completed signs shall be free from defects in materials and workmanship and effectively present specified message under both day and night viewing conditions. Sign faces shall be reasonably smooth, shall exhibit uniform color and brightness over entire background surface and shall not appear mottled, streaked, or stained when viewed either in ordinary daylight or incidental beams of automobile headlamps.

D. Support structures for signs that are free-standing or extending from any exterior surface of the building, including but not limited roof level parking signs on cantilever supports, shall be designed in accordance with ASCE 7-98's requirements for wind loads.

E. Internally illuminated or electrified sign cases (SA, TC, CM, DM, and I): Housing shall be waterproof and shall comply with NEMA Standards Publication 250-Enclosures for Electrical Equipment, for Type 4 enclosures.

F. Electrical Components, Devices and Accessories: All components shall be listed and labeled by UL and shall comply with NEMA and NFPA standards.

G. Electrical Service: Sign contractor shall review electrical drawings and coordinate with electrical contractor for any minor changes to design and installation of equipment and/or electrical service for powering signs and/or illumination thereof. Should it be possible that change order(s) will be necessary, use the Request for Information process.

H. Electrical Service: Sign contractor shall be responsible for design and installation of all electrical equipment for powering signs, and for design and installation of necessary electrical service from panel boards to signs.

I. Regulatory Requirements: Comply with Americans with Disabilities Act (ADA) and state and local codes as adopted by authorities having jurisdiction. Signs affected, may include, but not be limited to:

1. Illuminated Exit Signs: Refer to Division 26.
2. Permanently Designated Rooms and Spaces: A- Signs.
3. Fire Doors.
4. Room Capacity.
5. Live Load Capacity.
6. Elevator Signs.
7. Stairway Identification.
8. Area of Rescue Assistance Identification.

J. Single-Source Responsibility: For each separate required type of sign as defined herein, obtain signs from a single firm specializing in this type of work so that there will be undivided responsibility for such work.

K. Design Criteria: Drawings indicate sizes, profiles, and dimensional requirements of signs. Other signs with deviations from indicated dimensions and profiles may be considered, provided deviations do not change design concept. Burden of proof of equality is on proposer.

L. Coordinate sign placement with structural configuration and lighting location. Before sign installation, arrange meeting with Engineer/Architect and lighting installer at site to review sign placement. Additional compensation not allowed for relocating signs after installation if relocation required due to conflicts with lighting or structure.

M. Provide written 5 year full replacement warranty to Owner that all signage will be free of defects due to workmanship and materials including, but not limited to, fading,

peeling, delamination, and installation. With no additional cost to Owner, repair all defects that develop during warranty period and all damage to other Work due to such defects. NOTE: Additional warranties apply to specific sign types and products, as specified herein.

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting and mounting. Where sizes of signs may be affected by dimensions of surfaces on which they are installed, verify dimensions by field measurement. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

1.6 COORDINATION

A. For signs to be supported by or anchored to permanent construction, advise installers of anchorage devices about specific requirements for said devices. Furnish templates for installation.

B. Coordinate location of remote transformers with building construction. Ensure that transformers are accessible after completion of Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Where named products are specified, subject to compliance with requirements specific to this project, provide either named product or an equivalent product by one of other manufacturers specified.

B. Manufacturers: Subject to compliance with requirements specific to this project, manufacturers listed in Part 2 are considered to have been prequalified in conformance with paragraph 1.4.A and B of this section:

1. Manufacturers of panel signs, including V-,R-,PP-,PS-,VR-, D- and EP- signs:

a. ABC Architectural Signing System, Division of Nelson-Harkins Industries.
b. Allenite, A Division of Allen Marking Products, Inc.
c. Andco Industries Corp.
d. APCO Graphics, Inc.
e. Architectural Graphics, Inc.
f. ASI Sign Systems, Inc.
g. Best Manufacturing Co.
h. Interstate Highway Sign Corp.
i. Henry Graphics.
j. Jarob Design, Inc.
k. Pannier Graphics.

l. Tapco.
m. Vomar.

2. Brailled Signs (A-):

a. Supersine Company.
b. Jet Signs.

3. Manufacturers of I- and non-illuminated EP- signs:

a. Andco Industries Corp.
b. ASI Sign Systems, Inc.
c. Interstate Highway Sign Company.
d. Vomar.

2.2 materials

A. Graphics:

1. Graphics shall be highest quality with sharp lines and smooth curves. Images shall be uniform colors and free from streaks or spotting.
2. Original art shall be provided digitally by designer in Adobe Photoshop format on a photo CD.
3. Content and Style: Provide sign copy that complies with requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.
4. Silk screening: Where specified, silk screening shall be highest quality, with sharp lines, no sawtooths, or uneven ink coverage.

a. Screens shall be photographically reproduced.
b. Background ink shall be process inks as recommended by manufacturer of substrate employed.
c. Ink application through screens: 1 flood pass and 1 print pass. Images: uniform color and ink thickness; free from squeegee marks and lines.
d. Signs: dry in adequate racks with 2 in. spacing for ample air flow and forced air drying and curing.
e. Package signs only after they have dried completely per ink manufacturer's time allowances.
f. Where reflective messages are specified to be reverse silk-screened with a non-reflective, opaque background, the sheeting material shall be 3M Scotchlite Engineer Grade Reflective Sheeting Series 3200 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type II, Section 718.01.
g. Where reflective messages are specified to be reverse silk-screened with a reflective, transparent background, the sheeting material shall be 3M Scotchlite High Intensity Grade Sheeting Series 3800 or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01.

5. Pressure applied graphics:

    a. Where pressure-applied graphics applied to a painted background are specified, the paint shall be flat, opaque acrylic polyurethane as recommended by manufacturer of substrate and graphic media.
    b. Where pressure-applied, reflective graphics on an opaque painted background are specified, letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electrocut Engineer Grade Sheeting Series 3260 material, colors as noted on drawings or equivalent. Edges shall be sealed per manufacturer recommendation.
    c. Where pressure-applied, reflective graphics on a reflective background are specified, the sheeting material shall be 3930 Hi Intensity Prismatic or equivalent meeting US Department of Transportation Standard Specification for Construction of Roads and Bridges on Federal Highway Products, 1985 FP-85, Type IIIA, Section 718.01. The letters shall be digitally produced, and cut by electronic cutting machines from 3M Scotchlite Electronic Cutable Film Series 1170, colors as noted on drawings or equivalent.
    d. Where pressure-applied, non-reflective graphics are specified, letters shall be digitally produced, and cut by computer-driven processes from 3M Scotchcal Electrocut 7725 film. Sign faces shall be clear coated with UV inhibitor and vandal resistor as recommended by sheeting manufacturer.
    e. Where electronically cut letters and symbols are specified, the inside corners shall be rounded using the largest radius consistent with acceptable appearance. Minimum radius shall be 1/8 inch on a 3 inch letter. Use prespacing tape as recommended by manufacturer of sheeting as a carrier for letters, numerals and symbols.

6. Digital Imaging: Where digital imaging for original art and multicolored graphics are specified.

    a. Where first surface, reflective graphics are specified, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchlite Plus Sheeting Series 680. Sign faces shall be over printed with clear UV inhibitor and vandal resistor as recommended by sheeting manufacturer.
    b. Where first surface non-reflective graphics are required, the image shall be electronically produced and electrostatically printed onto the transfer media and then heat transferred onto 3M Scotchprint Marking Film 8620. Sign faces shall be over-printed with UV inhibitor and vandal resistor as recommended by sheeting manufacturer.
    c. Where second surface, non-reflective graphics are required, the image shall be produced using 3M Scotchprint Electronic Graphics System using Scotchcal 7725 marking film and lamination.

7. Where specified, dry film transfer shall be produced digitally using computer-driven Dry Thermal Transfer system over 3M high intensity reflective vinyl substrates.
8. All products specified to employ 3M sheeting, films, or other components shall be guaranteed and backed by 3M MCS Warranty or equivalent.

B. Inks and Paints:

1. All inks and paints shall be a type made for surface material to which it is applied, and recommended by manufacturer. Exact identification shall be noted on shop drawings, with data describing application method, if other than air-drying. Prohibited: paint or ink that will fade, discolor, or delaminate due to UV or heat exposure.
2. All colors for which color match specified shall be approved by Engineer/Architect prior to production.
3. Acceptable manufacturers and suppliers of inks for silk-screening shall be only those materials recommended by the manufacturer of the sheeting and as required for 3M MCS warranty, or equivalent, where applicable.
4. Paints: all materials best quality. Products of DuPont DeNemours & Company, Pittsburgh Plate Glass Company, Glidden, Matthews or Sherwin-Williams acceptable.

    a. Opaque background for pressure applied graphics: Two part acrylic polyurethane, low gloss. Care shall be taken to provide proper curing so that outgassing does not occur after application of sheeting and/or graphics.
    b. Painted graphics on steel doors: Refer to Painting specification section 09910.3.6.C. Ferrous metal paint selection for door base. Graphics paint to be compatible with base paint.
    c. Base for painted graphics on concrete, stucco, masonry and concrete masonry units to be prepared per Paint specifications. Graphics two part acrylic polyurethane, low gloss.
    d. High gloss enamel base: Graphics medium to be determined by installer. Primer may be required.

5. Applied color whether ink or paint shall conform to color and accelerated weathering requirements of FP-79 and shall not be removable when tested by Film Adhesion Test and by Film Hardness Test.

C. Blank Panels: Comply with requirements indicated for materials, thickness, finish, color, design, shape, size, and details of construction.

1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 0.0625 in. measured diagonally.
2. The back side and edges of all panel signs shall be painted with acrylic polyurethane, color to match the specified background color.
3. Edge Condition: Square cut.
4. Corner Condition: 1.5 in. radius unless otherwise indicated on Drawings.
5. Where aluminum panels are specified, meet following:

    a. Provide aluminum sheet of 6061-T6 or 5052-H38 alloys and temper recommended by aluminum producer or finisher for use type and finish indicated, and with not less than strength and durability properties specified in ASTM B209 for 5005-H15.

b. Aluminum extrusions shall be of alloy and temper recommended by aluminum producer for type of use and finish and with not less than strength and durability properties specified in ASTM B221 for 6063-T5.
c. Panels shall be etched, degreased, flat, and free of ragged edges. Radius corners by stamping. All signs of same size shall be totally uniform in size. Surface shall be completely clear of dust and dirt before finishes applied.
d. Panels to receive 3M sheeting and/or paint shall be treated with an anodizing conversion coating to provide resistance to corrosion and white rust formation. Conversion coating may be:

1) Chromate, meeting ASTM B449 class 2. Coating weight should be 10 to 35 mg per sq ft with a median of 25 mg per square foot. Coating shall not be dusty and shall be tightly bonded within itself and to the aluminum substrate.
2) Non-chromate coatings must meet the requirements for ASTM B449 class 1 chromate coatings. The non-chrome coating shall be adherent and non-powdery. Adhesion of air dried acrylic coating shall meet ASTM D 3359 or ASTM D 4541 and must be equivalent to that of the coating on chromate coated aluminum of the same alloy.

e. Fabricate aluminum signs with adequately sized, full-length stiffener members as indicated on Drawings.

D. V- Signs: Vehicular signs with reflective graphics and message on an opaque background.

1. Base materials:

a. Aluminum with either reverse silk screened graphics or pressure-applied letters.

2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed.

a. Pressure applied reflective letters/symbols.
b. Silk screened; background inks shall be opaque.
c. Digitally produced graphic media with reflective messages and graphics.

E. R- Regulatory vehicular signs with reflective graphics and message on a reflective background.

1. Base material: Aluminum.
2. R signs shall have reflective messages and reflective background using either silk screening or pressure applied reflective letters and symbols.

F. PP- Pedestrian Panel Wayfinding and Directional Signs.

1. Base materials:

a. Aluminum with either reverse silk screened graphics or pressure-applied letters.

2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:

    a. Pressure applied non-reflective letters/symbols.
    b. Silk screened over a flat opaque background.
    c. Original art and/or multi-color graphics shall be digitally produced on graphic media.

G. PS-Supergraphics, Pedestrian Wayfinding and Directional Signs:

1. Painted Super-Graphics: Where graphics painted directly on walls, doors or other surfaces are specified, message template to be:

    a. Pressure applied electronically cut graphics.
    b. Adhesive masking paper with digitized characters.

2. Apply primer and/or background color as specified on the drawings to surface as required. Sign contractor shall assure that paint employed for graphics is compatible with surface treatment(s) by others, including but not limited to concrete sealers and/or form release agents.

H. PVC- Signs: PVC pipe clearance signs shall have pressure applied letters on painted PVC pipe.

1. Electronically cut letters: 3M Scotchlite 3840 reflective sheeting.
2. 10 in. diameter, Schedule 40 PVC pipe, Corrosion Fluid Products Corporation, Addison, IL, or accepted equivalent.
3. Paint: "Spraylat" Lacryl B No. 482 High Hiding Black. Meet Lacryl system specifications for painting on PVC.

I. A- Signs: All signs required to be brailled in compliance with ADA requirements for designating permanent rooms and spaces shall comply with ADA Accessibility Guidelines (ADAAG) as published by the Architectural and Transportation Barriers Compliance Board and ICC/ANSI A117.1. latest editions.

1. Aluminum:

    a. Text to be produced with Supersine process die-cut raised letters and brailled copy.

2. Phenolic-Backed Photopolymer Sheet, “Jet-388 Phenolic Signage” by JetUSA or equivalent. Provide light sensitive, water-wash photopolymer face layer bonded to a phenolic base layer to produce composite sheet with overall thickness of 0.15 inches, and substrate thickness of 0.12 inches and a Type D Shore Durometer hardness of 95.
3. Lettering and Grade II brailled to be raised 1/32”. Lettering to be painted white matte finish. Grade II brailled to be painted out with matte finish background in color shown on drawings. Edges painted same as face.
4. Produce precisely formed characters with square cut edges free from burrs and cut marks.
5. Fasteners shall be mechanical, concealed and tamper proof.

J. Dimensional Characters (D-Signs):
   1. Cast Acrylic Sheet: Acrylite FF or equivalent. Cut characters from solid plate.
   2. Characters shall have smooth flat faces, sharp corners and precisely formed lines and profiles, free from pits scale, sand holes and other defects. Cast lugs into back of characters and tap to receive threaded mounting studs.
   3. Illuminated characters: Illuminate characters in manner indicated using manufacturer's standard lighting components, including light source, transformers, insulators and other components. Make provisions for servicing and concealing connections to building electrical system.

      a. Back-lighted characters: Provide concealed [neon tubes, fiber optics] required by size of characters. Include manufacturer's hardware for projection mounting of characters at distance from wall surface indicated.
      b. Face-lighted characters: Fabricate character faces from translucent acrylic sheet of thickness indicated. Attach characters to sheet metal back channels. Provide lighting tubes of number and spacing required to illuminate sign faces evenly.

K. Internally Illuminated Signs (I Signs):

   1. Sign design, construction fabrication and assembly shall be contractor responsibility, subject to Engineer's review. Fiberglass reinforced plastic (FRP) or aluminum cabinets are acceptable. Colors shall be as specified on drawings.
   2. Aluminum panels, when proposed, to be extruded, anodized aluminum with welded corners and aluminum tube framing as required for straight profiles. Case shall be finished with baked enamel or duranodic in color as shown as shown on the drawings. Illuminated messages, where required, shall be precision cut and filled with translucent material. Illuminated graphics shall be integral and flush with sign face for flat appearance. Raised letters or those projecting beyond sign face will not be accepted.
   3. Fiberglass panels, where proposed, shall be 3/16 inches with integral molded side returns mounted to an aluminum casing supported by aluminum framework. Posts to match specified cabinet color. Illuminated message shall be subsurface printed, and integral with sign face. Illuminated single color messages without original art may be translucent. Multi-color messages or signs with original art shall be digitally produced using 3M Electronic Graphics system and Scotchcal marking films. Provide matte UV and vandal resistant overcoat.
   4. Non-illuminated messages, where specified, shall employ any of the following methods:

      a. Pressure applied non-reflective letters/symbols.
      b. Silk screened.
      c. Digitally produced graphic media.

   5. Full message where shown shall be LED letters. Full message shall not be readable when turned off. Full message shall be controlled by PARCS system.
   6. No buckling, weaving, or oil canning of face panels.
   7. Sign mounting shall be as noted as drawings from among following:

      a. Wall or ceiling mount: Provide mounting channel brackets as required by sign size and location.

b. Post mount: Sign to be mounted on aluminum posts at both ends, with base plate bolted to concrete foundation to below local frost depth or a minimum of 1/3 the pole height which ever is greater. Coordinate anchor bolt locations with general contractor.
c. Concrete pedestal mount. Sign to be mounted on concrete pedestal as detailed on drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
d. Aluminum pedestal mount: Provide aluminum pedestal cover per drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.

8. All fasteners and brackets shall be non-corrosive.
9. All electrical connections shall be concealed but accessible and serviceable.
10. Interior of cabinet to be primed and painted white with acrylic polyurethane, high gloss finish.
11. Illumination shall be designed by contractor. Incandescent light sources will not be accepted. Each sign shall contain terminal board with adequate wiring. Lamps to be spaced to prevent shadows and hot spots. Uneven illumination will be rejected. Ballast shall be appropriate to temperature ranges at project site. Minimum luminance of sign message shall be 10 cd/m² at night and 30 cd/m² during the day.

L. Exterior non-illuminated panel signs (EP- Signs):

1. Sign design, construction fabrication and assembly shall be contractor responsibility. Where free-standing, supports shall meet AASHTO Standard Specifications for Highway Signs, Luminaries and Traffic Signals (Latest edition.) FRP or aluminum panels are acceptable. Wood not acceptable.
2. Graphics and Copy: Any of the following methods of producing graphics and copy may be employed:

a. Pressure applied reflective, letters/symbols.
b. Silk screened.
c. Digitally produced graphic media.

3. No buckling, weaving, or oil canning of face panels will be accepted.
4. Sign mounting to be as noted as drawings from among following:

a. Wall or ceiling mount: Provide mounting channel brackets as required by sign size and location.
b. Post mount: Sign to be mounted on aluminum posts at both ends, with base plate bolted to concrete foundation to below local frost depth or a minimum of 2’6”, which ever is greater. Coordinate anchor bolt locations with general contractor.
c. Flag mount: Sign to be mounted on single aluminum post, with base plate bolted to concrete foundation to below local frost depth or a minimum of 2’6”, which ever is greater. Coordinate anchor bolt locations with general contractor.
d. Concrete pedestal mount: Sign to be mounted on concrete pedestal of dimensions detailed on drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.

e. Aluminum pedestal mount: Provide aluminum pedestal cover per drawings. Coordinate anchor bolt, post sleeves and concealed electrical connections with pedestal contractor.
f. Overhead mount: Where overhead signs are to be mounted over roadways, support frame shall be designed in accordance with state department of transportation requirements for overhead signs.

5. All fasteners and brackets to be non-corrosive.
6. Externally illuminated panels: Where specified, illuminate panels in manner indicated using manufacturer's standard lighting components, including light source, transformers, insulators and other components. Make provisions for servicing and concealing connections to building electrical system. Provide lighting tubes of number and spacing required to illuminate sign faces evenly.

M. Fasteners and Supports:

1. Bolts, nylon insert lock nuts: ASTM A 320, Grade B stainless steel.
2. Rivets for signs: ASTM B 316, Alloy 6063-T61 or equivalent. Aluminum alloy blind rivets of self-plugging variety may be substituted for solid aluminum alloy rivets, subject to acceptance by Engineer/Architect.
3. Use concealed fasteners fabricated from metals not corrosive to sign material and mounting surface.
4. Anchors and Inserts: Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled in place anchors. Furnish inserts, as required, to be set into concrete or masonry work.
5. Sign posts: ASTM A 499 Grade 60 or ASTM A 576, Grade 1080 and meeting mechanical properties specified in ASTM A 499 for Grade 60 steel.
6. Posts shall be zinc coated per ASTM A 123. Posts shall be straight, with smooth, uniform finish, free from defects affecting strength, durability, or appearance. Punch bolt holes such that post face shall be smooth and even. All holes and ends shall be burr free. After all fabrication, flow coat posts with durable, exterior type, rust inhibiting paint. Paint color: black, unless otherwise indicated on Drawings.

N. Cantilever Sign Supports:

1. Pipe for poles and arms: steel pipe, ASTM A53, Grade B, Type E or S.
2. Gusset, flange, and base plates: ASTM A 36.
3. Castings: Free of sharp edges and irregularities. Pole top and end cap castings: ASTM A 126, Class A.
4. Bolts: Connect arm connection flanges with galvanized high strength steel bolts, nuts, and washers per ASTM A 325. Hot dip galvanize fasteners per ASTM A 153. Galvanized nuts shall be tapped oversized per ASTM A 563, and Supplementary requirement S1, "Lubricant and Test for Coated Nuts."
5. Welding: Applicable requirements of Sections of Division 05.

PART 3 - EXECUTION

3.1 SURFACE PREPARATION OF SUBSTRATE FOR PAINTED SIGNS

A. Prepare and clean in strict accordance with paint manufacturer's instructions and as specified here, for each substrate condition.

B. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so contaminants from cleaning process will not fall onto wet, newly painted surfaces.

C. Cementitious Surfaces:

1. Prepare surfaces to be painted by removing all efflorescence, chalk, dust, dirt, grease, oils, and, by roughening as required, glaze.
2. Determine alkalinity and moisture content of surfaces to be painted by appropriate testing. If surfaces found to be sufficiently alkaline to cause blistering and burring of finish paint, correct before painting. Do not paint on surfaces with moisture content exceeds manufacturer's limits.

D. Ferrous Metals: Clean uncoated ferrous surfaces of oil, grease, dirt, loose mill scale, and other foreign substances by solvent or mechanical cleaning. Clean previously coated metals in accordance with manufacturer recommendation.

3.2 MATERIALS PREPARATION FOR PAINTED SIGNS

A. Mix and prepare painting materials per manufacturer's directions.

B. Store materials not in use in tightly covered containers. Keep all containers clean, free of foreign materials and residue.

C. Stir materials before applying to produce uniform mixture, and stir as required during application. Do not stir surface film into material. Remove film and strain material before using if necessary.

3.3 INSTALLATION

A. General: Locate signs where shown using mounting methods of type described and in compliance with manufacturer's instructions. Install sign units level, plumb, and at height shown, with sign surfaces free from appearance defects.

B. For drilled anchors in concrete, verify location of embedded reinforcing steel, post-tensioning, or pre-stressing cables prior to installation.

C. Wall Mounted Panel Signs: Attach to wall surfaces with Hilti "Hit" anchors or ITW Ramset/Red Head Hammer Set anchors into concrete or masonry surfaces as shown on Drawings. DO NOT OVERDRIVE anchors, as overdriven anchors will damage sign faces and spall concrete.

D. Bracket Mounted Units: Provide manufacturer's standard brackets, fittings, and hardware as appropriate for mounting signs which project at right angles from walls or

ceilings. Attach brackets securely to walls or ceilings with concealed fasteners and anchors per manufacturer's directions.

E. Installation of signs shall conform to requirements of Americans with Disabilities Act (ADA) and/or state or local accessibility standards.

3.4 CLEANING AND PROTECTION

A. At completion of installation, clean soiled sign surfaces in accordance with manufacturer's instructions. Protect units from damage until acceptance by Owner.

B. Cleanup: During progress of Work, remove from site all discarded materials and rubbish at end of each day.

C. Upon completion of painting, clean all paint spattered surfaces. remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

D. Protection: Protect work of other trades, whether to be painted or not, against damage by painting and finishing. Correct any damage by cleaning, repairing, or replacing, and repainting, as acceptable to Engineer/Architect.

E. Provide "Wet Paint" signs as required.

END OF SECTION 101400

SECTION 104400 - FIRE-PROTECTION SPECIALTIES

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. Portable fire extinguishers.
2. Fire-protection cabinets for the following:

    a. Portable fire extinguishers.

B. Related Sections include the following:

1. Division 09 painting Sections for field painting fire-protection cabinets.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire-protection cabinets.

1. Fire Extinguishers: Include rating and classification.
2. Fire-Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Samples for Initial Selection: For fire-protection cabinets with factory-applied color finishes.

C. Samples for Verification: For each type of exposed factory-applied color finish required for fire-protection cabinets, prepared on Samples of size indicated below.

1. Size: 6 by 6 inches square.

D. Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain fire extinguishers and fire-protection cabinets through one source from a single manufacturer.

B. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

C. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

1.6 SEQUENCING

A. Apply decals on field-painted fire-protection cabinets after painting is complete.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of portable fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Aluminum: Alloy and temper recommended by aluminum producer and manufacturer for type of use and finish indicated, and as follows:

1. Sheet: ASTM B 209.
2. Extruded Shapes: ASTM B 221.

C. Tempered Break Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 1.5 mm thick.

2.3 PORTABLE FIRE EXTINGUISHERS

A. Manufacturers:

1. Amerex Corporation.
2. Ansul Incorporated.
3. Badger Fire Protection.
4. Buckeye Fire Equipment Company.
5. Fire End & Croker Corporation.
6. General Fire Extinguisher Corporation.
7. JL Industries, Inc.
8. Kidde Fyrnetics.
9. Larsen's Manufacturing Company.
10. Modern Metal Products; Div. of Technico.
11. Moon American.
12. Potter Roemer; Div. of Smith Industries, Inc.
13. Watrous; Div. of American Specialties, Inc.

B. General: Provide fire extinguishers of type, size, and capacity for each fire-protection cabinet and mounting bracket indicated.

1. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

C. Multipurpose Dry-Chemical Type: UL-rated 20-A:120-B:C, 20-lb nominal capacity, with monoammonium phosphate-based dry chemical in manufacturer's standard enameled container.

2.4 FIRE-PROTECTION CABINET

A. Manufacturers:

1. Fire End & Croker Corporation.
2. General Accessory Mfg. Co.
3. Guardian Fire Equipment, Inc.
4. JL Industries, Inc.
5. Kidde Fyrnetics.
6. Larsen's Manufacturing Company.
7. Modern Metal Products; Div. of Technico.
8. Moon American.

9. Potter Roemer; Div. of Smith Industries, Inc.
10. Watrous; Div. of American Specialties, Inc.

B. Cabinet Type: Suitable for fire extinguisher.

C. Cabinet Construction: Nonrated.

D. Cabinet Material: Enameled-steel (covered levels), HPS plastic (rooftop).

E. Surface-Mounted Cabinet: Cabinet box fully exposed and mounted directly on column or wall; with no trim.

F. Door Material: Same as cabinet.

G. Door Style: Fully glazed panel with frame.

H. Door Glazing: Tempered break glass.

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Break-Glass Strike: Manufacturer's standard metal strike, complete with chain and mounting clip, secured to cabinet.
3. Door Lock: Cylinder lock, keyed alike to other cabinets.
4. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Engineer.

a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."

1) Location: Applied to cabinet glazing.
2) Application Process: Pressure-sensitive vinyl letters.
3) Lettering Color: Red.
4) Orientation: Vertical.

b. Provide 3-way visible sign, surface mounted above cabinet, at locations where fire extinguisher and cabinet may be obstructed or obscured from view by parked vehicles.

K. Finishes:

1. Manufacturer's standard baked-enamel paint for the following:

a. Exterior of cabinet, door, and trim, except for those surfaces indicated to receive another finish.
b. Interior of cabinet and door.
c. Color and Texture: White.

2.5 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.6 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.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 STEEL FINISHES

A. Surface Preparation: Clean surfaces of dirt, oil, grease, mill scale, rust, and other contaminants that could impair paint bond using manufacturer's standard methods.

B. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment.

1. Shop Primer: Manufacturer's or fabricator's standard, fast-curing, lead- and chromate-free, universal primer, selected for resistance to normal atmospheric corrosion, for compatibility with substrate and field-applied finish paint system indicated, and for capability to provide a sound foundation for field-applied topcoats despite prolonged exposure.

C. Baked-Enamel Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-enamel finish consisting of prime coat and thermosetting topcoat. Comply with paint manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable support where cabinets will be installed.

B. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged units.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire-protection specialties in locations and at mounting heights indicated or, if not indicated, at heights indicated below and acceptable to authorities having jurisdiction.

1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten fire-protection cabinets to structure, square and plumb.

1. Provide inside latch and lock for break-glass panels.
2. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

D. Identification: Apply decals at locations indicated.

3.3 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection specialties are installed, unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet manufacturer.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 00

SECTION 142400 - HYDRAULIC ELEVATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes hydraulic passenger elevators.

B. Related Requirements:

1. Division 03 Section "Cast-in-Place Concrete" for setting sleeves, inserts, and anchoring devices in concrete.
2. Division 05 Section "Structural Steel Framing" for the following:

    a. Attachment plates, angle brackets, and other preparation of structural steel for fastening guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills that are part of steel frame.

3. Division 05 Section "Metal Fabrications" for the following:

    a. Attachment plates and angle brackets for supporting guide-rail brackets.
    b. Divider beams.
    c. Hoist beams.
    d. Structural-steel shapes for subsills.
    e. Pit ladders.
    f. Cants in hoistways made from steel sheet.

4. Division 05 Section "Pipe and Tube Railings" for railings between adjacent elevator pits.
5. Division 09 painting Sections for field painting of hoistway entrance doors and frames.
6. Division 22 Section "Sump Pumps" for sump pumps, sumps, and sump covers in elevator pits.
7. Division 26 Sections for electrical service for elevators to and including fused disconnect switches at machine room door and standby power source, transfer switch, and connection from auxiliary contacts in transfer switch to controller.
8. Division 27 Section "Communications Horizontal Cabling" for telephone service for elevators.

9. Division 28 Section "Digital, Addressable Fire-Alarm System" for smoke detectors in elevator lobbies to initiate emergency recall operation and for connection to elevator controllers.
10. Division 31 Section "Earth Moving" for excavating well hole to accommodate cylinder assembly.

1.3 DEFINITIONS

A. Definitions in ASME A17.1/CSA B44 apply to work of this Section.

B. Service Elevator: A passenger elevator that is also used to carry freight.

1.4 ACTION SUBMITTALS

A. Product Data: Include capacities, sizes, performances, operations, safety features, finishes, and similar information. Include product data for car enclosures, hoistway entrances, and operation, control, and signal systems.

B. Shop Drawings:

1. Include plans, elevations, sections, and large-scale details indicating service at each landing, machine room layout, coordination with building structure, relationships with other construction, and locations of equipment.
2. Include large-scale layout of car-control station and standby power operation control panel.
3. Indicate maximum dynamic and static loads imposed on building structure at points of support, and maximum and average power demands.

C. Samples for Initial Selection: For finishes involving color selection.

D. Samples for Verification: For exposed car, hoistway door and frame, and signal equipment finishes; 3-inch- (75-mm-) square Samples of sheet materials; and 4-inch (100-mm) lengths of running trim members.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Certificates: For elevator equipment, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Certificates: Signed by elevator manufacturer certifying that hoistway, pit, and machine room layout and dimensions, as shown on Drawings, and electrical service including standby power generator, as shown and specified, are adequate for elevator system being provided.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For elevators to include in emergency, operation, and maintenance manuals.

B. Inspection and Acceptance Certificates and Operating Permits: As required by authorities having jurisdiction for normal, unrestricted elevator use.

C. Continuing Maintenance Proposal: Submit a continuing maintenance proposal from Installer to Owner, in the form of a standard **one-year** maintenance agreement, starting on date initial maintenance service is concluded. State services, obligations, conditions, and terms for agreement period and for future renewal options.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Elevator manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle materials, components and equipment in manufacturer's protective packaging. Store materials, components, and equipment off of ground, under cover, and in a dry location.

1.9 COORDINATION

A. Coordinate installation of sleeves, block outs, elevator equipment with integral anchors, and other items that are embedded in concrete or masonry for elevator equipment. Furnish templates, sleeves, elevator equipment with integral anchors, and installation instructions and deliver to Project site in time for installation.

B. Furnish well casing and coordinate delivery with related excavation work.

C. Coordinate locations and dimensions of other work relating to hydraulic elevators including pit ladders; sumps and floor drains in pits; entrance subsills; electrical service; and electrical outlets, lights, and switches in hoistways, pits, and machine rooms.

1.10 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair, restore, or replace elevator work that fails in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, operation or control system failure, including excessive malfunctions; performances below specified ratings; excessive wear; unusual deterioration or aging of materials or finishes; unsafe conditions; need for excessive maintenance; abnormal noise or vibration; and similar unusual, unexpected, and unsatisfactory conditions.
2. Warranty Period: two (2) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

B. Basis-of-Design Product: Subject to compliance with requirements, provide by one of the following:

1. American Crescent Elevator Mfg., Corp.
2. Fujitec America, Inc.
3. KONE Inc.
4. Minnesota Elevator, Inc.
5. Mowrey Elevator Co.
6. Otis Elevator Co.
7. Schindler Elevator Corp.
8. Schumacher Elevator Co.
9. ThyssenKrupp Elevator.

C. Source Limitations: Obtain elevators from single manufacturer.

1. Major elevator components, including pump-and-tank units, plunger-cylinder assemblies, controllers, signal fixtures, door operators, car frames, cars, and entrances, shall be manufactured by single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Regulatory Requirements: Comply with ASME A17.1/CSA B44.

B. Accessibility Requirements: Comply with Section 407 in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and with ICC A117.1.

C. Seismic Performance: Elevator system shall withstand the effects of earthquake motions determined according to [ASCE/SEI 7] <Insert requirement> and shall comply with elevator safety requirements for seismic risk Zone 2 or greater in ASME A17.1/CSA B44.

1. The term "withstand" means "the system will remain in place without separation of any parts when subjected to the seismic forces specified[and the system will be fully operational after the seismic event]."
2. Affected peak velocity acceleration (Av) for Project's location is [less than 0.10 (seismic risk Zones 0 and 1)] [greater than or equal to 0.10, but less than 0.20 (seismic risk Zone 2)] [greater than or equal to 0.20 (seismic risk Zones 3 and 4)].
3. Provide earthquake equipment required by ASME A17.1/CSA B44.
4. Provide seismic switch required by ASCE/SEI 7.
5. Design earthquake spectral response acceleration short period (Sds) for Project
6. Project's Seismic Design Category.
7. Elevator Component Importance Factor

2.3 ELEVATORS

A. Elevator System, General: Manufacturer's standard elevator systems. Unless otherwise indicated, manufacturers' standard components shall be used, as included in standard elevator systems and as required for complete system.

B. Elevator Description:

1. Group Number: 1.
2. Elevator Number(s): 1 & 2
3. Type: Under-the-car single cylinder.
4. Rated Load: 4000 lb (1589 kg).
5. Rated Speed: 200 fpm (1.0 m/s).
6. Operation System: Group automatic.
7. Auxiliary Operations:

    a. Standby power operation.
    b. Standby-powered lowering.
    c. Battery-powered lowering.
    d. Automatic dispatching of loaded car.
    e. Nuisance call cancel.
    f. Priority service at all floors.
    g. Loaded-car bypass.

8. Security Features: Keyswitch operation.
9. Car Enclosures:

    a. Inside Width: 92 inches (2337 mm) from side wall to side wall.
    b. Inside Depth: 65 inches (1651 mm) from back wall to front wall (return panels).
    c. Inside Height: 92 inches (2337 mm) to underside of ceiling.

d. Front Walls (Return Panels): Satin stainless steel, No. 4 finish with integral car door frames.
e. Car Fixtures: Satin stainless steel, No. 4 finish.
f. Side and Rear Wall Panels: Satin stainless steel, No. 4 finish with glass along rear wall.
g. Reveals: Satin stainless steel, No. 4 finish.
h. Door Faces (Interior): Satin stainless steel, No. 4 finish.
i. Door Sills: Aluminum.
j. Ceiling: Polished stainless steel, No. 8 finish.
k. Handrails: 1-1/2 inches (38 mm) round satin stainless steel, No. 4 finish, at sides and rear of car.
l. Floor: Manufacturer's standard carpet.
m. Floor prepared to receive resinous flooring (specified in a Division 09 flooring Section).

10. Hoistway Entrances:

a. Width: 48 inches (1219 mm).
b. Height: 84 inches (2134 mm).
c. Type: Single-speed center opening.
d. Frames at First Floor: Satin stainless steel, No. 4 finish.
e. Frames at Other Floors: Satin stainless steel, No. 4 finish.
f. Doors at First Floor: Satin stainless steel, No. 4 finish.
g. Doors at Other Floors: Satin stainless steel, No. 4 finish.
h. Sills at First Floor: Aluminum.
i. Sills at Other Floors: Aluminum.

11. Hall Fixtures at First Floor: Satin stainless steel, No. 4 finish.
12. Hall Fixtures at Other Floors: Satin stainless steel, No. 4 finish.
13. Additional Requirements:

a. Provide inspection certificate in each car, mounted under acrylic cover with frame made from satin stainless steel, No. 4 finish.

2.4 SYSTEMS AND COMPONENTS

A. Pump Units: Positive-displacement type with a maximum of 10 percent variation between no load and full load and with minimum pulsations.

1. Pump shall be tank-top-mounted type with fan-cooled, squirrel-cage induction motor, and shall be mounted on oil tank with vibration isolation mounts and enclosed in prime-painted steel enclosure lined with 1-inch- (25-mm-) thick, glass-fiber insulation board.
2. Motor shall have solid-state starting.
3. Motor shall have variable-voltage, variable-frequency control.

B. Hydraulic Silencers: System shall have hydraulic silencer containing pulsation-absorbing material in blowout-proof housing at pump unit.

C. Piping: Size, type, and weight of piping as recommended by elevator manufacturer, with flexible connectors to minimize sound and vibration transmissions from power unit.

1. Cylinder units shall be connected with dielectric couplings.
2. Casing for Underground Piping: Schedule 40 PVC pipe complying with ASTM D 1785, joined with PVC fittings complying with ASTM D 2466 and solvent cement complying with ASTM D 2564.

D. Hydraulic Fluid: Nontoxic, biodegradable , fire-resistant fluid made from vegetable oil with antioxidant, anticorrosive, antifoaming, and metal-passivating additives and approved by elevator manufacturer for use with elevator equipment.

1. Product: Subject to compliance with requirements, provide "Hydro Safe" by Hydro Safe Oil Division, Inc.

E. Inserts: Furnish required concrete and masonry inserts and similar anchorage devices for installing guide rails, machinery, and other components of elevator work. Device installation is specified in another Section.

F. Protective Cylinder Casing: PVC or HDPE pipe casing complying with ASME A17.1/CSA B44, of sufficient size to provide not less than 1-inch (25-mm) clearance from cylinder and extending above pit floor. Casing shall have means of monitoring effectiveness to comply with ASME A17.1/CSA B44.

G. Corrosion-Protective Filler: A nontoxic, petroleum-based gel formulated for filling the space between hydraulic cylinder and protective casing. Filler shall be electrically nonconductive, displace or absorb water, and gel or solidify at temperatures below 60 deg F (16 deg C).

1. Products: Subject to compliance with requirements, provide one of the following:

a. Hydro Safe Oil Division, Inc.; No-Ox-Id Liquid Elevator Casing Filler E-800.
b. Union-Gard, a division of Dome Services L.L.C.; Union-Gard 160.
c. Approved product similar in design, construction, and performance.

H. Car Frame and Platform: Welded steel units.

I. Guides: Roller guides; polymer-coated, nonlubricated sliding guides; or sliding guides with guide-rail lubricators. Provide guides at top and bottom of car and counterweight frames.

2.5 OPERATION SYSTEMS

A. General: Provide manufacturer's standard microprocessor operation system as required to provide type of operation indicated.

B. Auxiliary Operations: In addition to primary operation system features, provide the following operational features for elevators where indicated:

1. Group Standby Power Operation: On activation of standby power, cars are returned to a designated floor and parked with doors open. Only one car is moved upward at a time, with priority given to loaded cars. If a car cannot be returned after two attempts, it is removed from the system. When all cars have been returned or removed from the system, one car is automatically placed in service. If car selected for service cannot operate within 60 seconds, the system removes car from service and places another car in service. Cars can be manually put in service on standby power, either for return operation or for regular operation, by switches in control panel located at main lobby. Manual operation causes automatic operation to cease.
2. Group Standby Power Operation: On activation of standby power, cars are returned to lowest floor and parked with doors open. If a car cannot be returned, it is removed from the system. One car is selected for service on standby power by a switch located at Ground Tier
3. Automatic Dispatching of Loaded Car: When car load exceeds 80 percent of rated capacity, doors start closing.
4. Nuisance Call Cancel: When car calls exceed a preset number while car load is less than a predetermined weight, all car calls are canceled. Preset number of calls and predetermined weight can be adjusted.
5. Loaded-Car Bypass: When car load exceeds 80 percent of rated capacity, car responds only to car calls, not to hall calls.

C. Security Features: Provide the following security features, where indicated. Security features shall not affect emergency firefighters' service.

1. Keyswitch Operation: Push buttons are activated and deactivated by security keyswitches at hall push-button stations. Key is removable only in deactivated position.

2.6 DOOR REOPENING DEVICES

A. Infrared Array: Provide door reopening device with uniform array of 36 or more microprocessor-controlled, infrared light beams projecting across car entrance. Interruption of one or more light beams shall cause doors to stop and reopen.

B. Nudging Feature: After car doors are prevented from closing for predetermined adjustable time, through activating door reopening device, a loud buzzer shall sound and doors shall begin to close at reduced kinetic energy.

2.7 CAR ENCLOSURES

A. General: Provide steel-framed car enclosures with nonremovable wall panels, with removable car roof, access doors, power door operators, and ventilation.

1. Provide standard railings complying with ASME A17.1/CSA B44 on car tops where required by ASME A17.1/CSA B44.

B. Materials and Finishes: Manufacturer's standards, but not less than the following:

1. Subfloor: Exterior, underlayment grade plywood, not less than 5/8-inch (15.9-mm) nominal thickness.
2. Floor Finish: Specified in a Division 09 Section.
3. Stainless-Steel Wall Panels: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
4. Fabricate car with recesses and cutouts for signal equipment.
5. Fabricate car door frame integrally with front wall of car.
6. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.
7. Sight Guards: Provide sight guards on car doors.
8. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
9. Luminous Ceiling: Fluorescent light fixtures and ceiling panels of translucent acrylic or other permanent rigid plastic.
10. Handrails: Manufacturer's standard handrails, of shape, metal, and finish indicated.
11. Glass: Laminated glass and metal frame per manufacturers' standard for glass back elevator cab with anti-graffiti film.

2.8 HOISTWAY ENTRANCES

A. Hoistway Entrance Assemblies: Manufacturer's standard horizontal-sliding, door-and-frame hoistway entrances complete with track systems, hardware, sills, and accessories. Frame size and profile shall accommodate hoistway wall construction.

1. Where gypsum board wall construction is indicated, frames shall be self-supporting with reinforced head sections.

B. Materials and Fabrication: Manufacturer's standards, but not less than the following:

1. Enameled-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
2. Primed-Steel Frames: Formed from cold- or hot-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
3. Steel Subframes: Formed from cold- or hot-rolled steel sheet, with factory-applied enamel finish or rust-resistant primer. Fabricate to receive applied finish as indicated.
4. Stainless-Steel Frames: Formed from stainless-steel sheet.
5. Star of Life Symbol: Identify emergency elevators with star of life symbol, not less than 3 inches (76 mm) high, on both inside surfaces of hoistway door frames.
6. Enameled-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied enamel finish; colors as selected by Architect from manufacturer's full range.
7. Primed-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet. Provide with factory-applied, rust-resistant primer for field painting.
8. Stainless-Steel Doors: Flush, hollow-metal construction; fabricated from stainless-steel sheet.

9. Unfinished-Steel Doors: Flush, hollow-metal construction; fabricated from cold-rolled steel sheet, with factory-applied enamel.
10. Sight Guards: Provide sight guards on doors matching door edges.
11. Sills: Extruded metal, with grooved surface, 1/4 inch (6.4 mm) thick.
12. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M.

2.9 SIGNAL EQUIPMENT

A. General: Provide hall-call and car-call buttons that light when activated and remain lit until call has been fulfilled. Fabricate lighted elements with LEDs.

B. Car-Control Stations: Provide manufacturer's standard recessed car-control stations. Mount in return panel adjacent to car door unless otherwise indicated.

1. Mark buttons and switches for required use or function. Use both tactile symbols and Braille.
2. Provide "No Smoking" sign matching car-control station, either integral with car-control station or mounted adjacent to it, with text and graphics as required by authorities having jurisdiction.

C. Emergency Communication System: Two-way voice communication system, with visible signal, which dials preprogrammed number of monitoring station and does not require handset use. System is contained in flush-mounted cabinet, with identification, instructions for use, and battery backup power supply.

D. Firefighters' Two-Way Telephone Communication Service: Provide telephone jack in each car and required conductors in traveling cable for firefighters' two-way telephone communication service specified in Division 28 Section "Digital, Addressable Fire-Alarm System."

E. Car Position Indicator: Provide illuminated, digital-type car position indicator, located above car door or above car-control station. Also, provide audible signal to indicate to passengers that car is either stopping at or passing each of the floors served. Include travel direction arrows if not provided in car-control station.

F. Hall Push-Button Stations: Provide one hall push-button station at each landing.

1. Provide units with flat faceplate for mounting with body of unit recessed in wall.
2. Equip units with buttons for calling elevator and for indicating applicable direction of travel.

G. Hall Lanterns: Units with illuminated arrows; but provide single arrow at terminal landings. Provide the following:

1. Manufacturer's standard wall-mounted units, for mounting above entrance frames.

H. Hall Annunciator: With each hall lantern, provide audible signals indicating car arrival and direction of travel. Signals sound once for up and twice for down.

1. At manufacturer's option, audible signals may be placed on cars.

I. Hall Position Indicators: Provide illuminated, digital-display-type position indicators, located above each hoistway entrance at ground floor. Provide units with flat faceplate for mounting and with body of unit recessed in wall.

J. Standby Power Elevator Selector Switches: Provide switches, as required by ASME A17.1/CSA B44, where indicated. Adjacent to switches, provide illuminated signal that indicates when normal power supply has failed.

K. Fire-Command-Center Annunciator Panel: Provide panel containing illuminated position indicators for each elevator, clearly labeled with elevator designation; include illuminated signal that indicates when elevator is operational and when it is at the designated emergency return level with doors open. Provide standby power elevator selector switch(es), as required by ASME A17.1/CSA B44, adjacent to position indicators. Provide illuminated signal that indicates when normal power supply has failed.

L. Emergency Pictorial Signs: Fabricate from materials matching hall push-button stations, with text and graphics as required by authorities having jurisdiction, indicating that in case of fire elevators are out of service and exits should be used instead. Provide one sign at each hall push-button station unless otherwise indicated.

2.10 FINISH MATERIALS

A. General: Provide the following materials for exposed parts of elevator car enclosures, car doors, hoistway entrance doors and frames, and signal equipment as indicated.

B. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, commercial steel, Type B, exposed, matte finish.

C. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, commercial steel, Type B, pickled.

D. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304.

E. Textured Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with embossed texture rolled into exposed surface.

1. Product: Subject to compliance with requirements, provide "**<Insert product name>**" by **<Insert manufacturer's name>**.
2. Metal surface is satin polished after texturing.

F. Stainless-Steel Bars: ASTM A 276, Type 304.

G. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

H. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elevator areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Verify critical dimensions and examine supporting structure and other conditions under which elevator work is to be installed.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Excavation for Cylinder: Drill well hole in elevator pit to accommodate installation of cylinder; comply with applicable requirements in Division 31 Section "Earth Moving."

B. Providewell casing as necessary to retain well-hole walls.

C. Install cylinder in protective casing within well hole. Before installing protective casing, remove water and debris from well hole and provide permanent waterproof seal at bottom of well casing.

1. Fill void space between protective casing and cylinder with corrosion-protective filler.
2. Align cylinders and fill space around protective casing with fine sand.

D. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor. Seal between well casing and pit floor with 4 inches (100 mm) of nonshrink, nonmetallic grout.

E. Install cylinder plumb and accurately centered for elevator car position and travel. Anchor securely in place, supported at pit floor and braced at intervals as needed to maintain alignment. Anchor cylinder guides at spacing needed to maintain alignment and avoid overstressing guides.

F. Welded Construction: Provide welded connections for installing elevator work where bolted connections are not required for subsequent removal or for normal operation, adjustment, inspection, maintenance, and replacement of worn parts. Comply with AWS workmanship and welding operator qualification standards.

G. Sound Isolation: Mount rotating and vibrating equipment on vibration-isolating mounts to minimize vibration transmission to structure and structure-borne noise due to elevator system.

H. Install piping above the floor, where possible. Install underground piping in casing.

I. Lubricate operating parts of systems as recommended by manufacturers.

J. Alignment: Coordinate installation of hoistway entrances with installation of elevator guide rails for accurate alignment of entrances with car. Where possible, delay installation of sills and frames until car is operable in shaft. Reduce clearances to minimum, safe, workable dimension at each landing.

K. Leveling Tolerance: 1/4 inch (6 mm), up or down, regardless of load and travel direction.

L. Set sills flush with finished floor surface at landing. Fill space under sill solidly with nonshrink, nonmetallic grout.

M. Locate hall signal equipment for elevators as follows, unless otherwise indicated:

1. For groups of elevators, locate hall push-button stations between two elevators at center of group or at location most convenient for approaching passengers.
2. Place hall lanterns either above or beside each hoistway entrance.
3. Mount hall lanterns at a minimum of 72 inches (1829 mm) above finished floor.

3.3 FIELD QUALITY CONTROL

A. Acceptance Testing: On completion of elevator installation and before permitting elevator use (either temporary or permanent), perform acceptance tests as required and recommended by ASME A17.1/CSA B44 and by governing regulations and agencies.

B. Advise Owner, Architect, and authorities having jurisdiction in advance of dates and times that tests are to be performed on elevators.

3.4 PROTECTION

A. Temporary Use: Comply with the following requirements for elevator used for construction purposes:

1. Provide car with temporary enclosure, either within finished car or in place of finished car, to protect finishes from damage.
2. Provide strippable protective film on entrance and car doors and frames.
3. Provide padded wood bumpers on entrance door frames covering jambs and frame faces.
4. Provide other protective coverings, barriers, devices, signs, and procedures as needed to protect elevator and elevator equipment.

5. Do not load elevators beyond their rated weight capacity.
6. Engage elevator Installer to provide full maintenance service. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleanup, and adjustment as necessary for proper elevator operation at rated speed and capacity. Provide parts and supplies same as those used in the manufacture and installation of original equipment.
7. Engage elevator Installer to restore damaged work, if any, so no evidence remains of correction. Return items that cannot be refinished in the field to the shop, make required repairs and refinish entire unit, or provide new units as required.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate elevator(s).

B. Check operation of each elevator with Owner's personnel present before date of Substantial Completion. Determine that operation systems and devices are functioning properly.

3.6 MAINTENANCE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include twelve (12) months' full maintenance by skilled employees of elevator Installer. Include monthly preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper elevator operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Perform maintenance during normal working hours.
2. Include 24-hour-per-day, 7-day-per-week emergency callback service.

END OF SECTION 142400

SECTION 21 05 17 - SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Sleeves.
2. Stack-sleeve fittings.
3. Sleeve-seal systems.
4. Sleeve-seal fittings.
5. Grout.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

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

E. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

G. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

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 product indicated on Drawings or comparable product by one of the following:

1. Smith, Jay R. Mfg. Co.
2. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

C. Description: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring, bolts, and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

B. Basis-of-DesignProduct: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. CALPICO, Inc.
3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc

C. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.

1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel].
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating,of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

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 product indicated on Drawings or comparable product by one of the following:

1. Presealed Systems.

C. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.

1. Sleeves are not required for core-drilled holes.

C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.

1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.

2. Cut sleeves to length for mounting flush with both surfaces.
   a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.

3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.

D. Install sleeves for pipes passing through interior partitions.

1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Section 079200 "Joint Sealants."

E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

A. Install stack-sleeve fittings in new slabs as slabs are constructed.

1. Install fittings that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
3. Install section of cast-iron soil pipe to extend sleeve to 2 inches (50 mm) above finished floor level.
4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
5. Using grout, seal the space around outside of stack-sleeve fittings.

B. Fire-Barrier Penetrations: Maintain indicated fire rating of floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.

B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Exterior Concrete Walls above Grade:
   a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves.
   b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves.
2. Exterior Concrete Walls below Grade:
   a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
3. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6 (DN 150): Cast-iron wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
   b. Piping NPS 6 (DN 150) and Larger: Cast-iron wall sleeves with sleeve-seal system.
      1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
4. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
   b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.
5. Interior Partitions:
   a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.

b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 21 05 17

SECTION 21 05 53 - IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

D. Valve Schedules: Valve numbering scheme.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each piping system to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Yellow.
4. 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).
5. 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.
6. Fasteners: Stainless-steel rivets or self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, with predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: Yellow.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).
5. 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).
6. 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.
7. Fasteners: Stainless-steel rivets or self-tapping screws].
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

D. 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) and 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, with predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

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 or 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 partially cover 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.

E. Pipe-Label Colors:

1. Background Color: Red.

2. Letter Color: White.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.

2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.

3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping-system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032 inch (0.8 mm) thick, with predrilled holes for attachment hardware.

2. Fasteners: Brass wire-link chain.

3. Valve-Tag Color: Red.

4. Letter Color: White.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.

2. Fasteners: [Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Yellow background with black lettering.

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 LABEL INSTALLATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping Color-Coding: Painting of piping is specified in Section 099123 "Interior Painting."

F. Stenciled Pipe-Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

G. Pipe-Label Locations: 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. 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.

3.3 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems. List tagged valves in a valve-tag schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:

1. Valve-Tag Size and Shape:
   a. Wet-Pipe Sprinkler System: 1-1/2 inches (38 mm).

3.4 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 21 05 53

SECTION 21 12 00 - FIRE-SUPPRESSION STANDPIPES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Hose connections.
4. Fire-department connections.
5. Alarm devices.

1.2 SYSTEM DESCRIPTIONS

A. Manual Dry-Type, Class I Standpipe System: Includes NPS 2-1/2 (DN 65) hose connections. Does not have permanent water supply. Piping is dry. Water must be pumped into standpipes to satisfy demand.

1.3 PERFORMANCE REQUIREMENTS

A. Fire-Suppression Standpipe System Component: Listed for 175-psig (1200-kPa) minimum working pressure.

B. Delegated Design: Design fire-suppression standpipes, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements as required by NFPA 14 and California Fire Code.

C. Fire-suppression standpipe design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is as follows:
   a. NPS 2-1/2 (DN 65) Hose Connections: 100 psig (690 kPa).

2. Maximum residual pressure at required flow at each hose-connection outlet is as follows unless otherwise indicated:
   a. NPS 2-1/2 (DN 65) Hose Connections: [175 psig (1200 kPa).

D. Seismic Performance: Fire-suppression standpipes shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-suppression standpipes. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For standpipe systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Approved Standpipe Drawings: Working plans, prepared according to NFPA 14, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

C. Welding certificates.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer's responsibilities include designing, fabricating, and installing fire-suppression standpipes and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. 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.

D. NFPA Standards: Fire-suppression standpipe equipment, specialties, accessories, installation, and testing shall comply with NFPA 14, "Installation of Standpipe and Hose Systems."

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Black-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B Pipe ends may be factory or field formed to match joining method.

B. Standard-Weight, Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, seamless steel pipe with threaded ends.

C. Uncoated, Steel Couplings: ASTM A 865, threaded.

D. Uncoated, Gray-Iron Threaded Fittings: ASME B16.4, Class 125, standard pattern.

E. Malleable- or Ductile-Iron Unions: UL 860.

F. Cast-Iron Flanges: ASME B16.1, Class 125.

G. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

H. Steel Welding Fittings: ASTM A 234/A 234M and ASME B16.9.

I. Grooved-Joint, Steel-Pipe Appurtenances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Anvil International, Inc.
    b. Corcoran Piping System Co.
    c. National Fittings, Inc.
    d. Shurjoint Piping Products.
    e. Tyco Fire & Building Products LP.
    f. Victaulic Company.

2. Pressure Rating: 175 psig (1200 kPa)minimum.
3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

2.3 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.

1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:

1. Valves shall be UL listed or FM approved.
2. Minimum Pressure Rating: 175 psig (1200 kPa).

B. Check Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. AFAC Inc.
b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
c. Anvil International, Inc.
d. Clow Valve Company; a division of McWane, Inc.
e. Crane Co.; Crane Valve Group; Crane Valves.
f. Crane Co.; Crane Valve Group; Jenkins Valves.
g. Crane Co.; Crane Valve Group; Stockham Division.
h. Fire-End & Croker Corporation.
i. Fire Protection Products, Inc.
j. Fivalco Inc.
k. Globe Fire Sprinkler Corporation.
l. Groeniger & Company.
m. Kennedy Valve; a division of McWane, Inc.
n. Matco-Norca.
o. Metraflex, Inc.
p. Milwaukee Valve Company.
q. Mueller Co.; Water Products Division.
r. NIBCO INC.
s. Potter Roemer.
t. Reliable Automatic Sprinkler Co., Inc.
u. Shurjoint Piping Products.
v. Tyco Fire & Building Products LP.
w. United Brass Works, Inc.

x. Venus Fire Protection Ltd.
y. Victaulic Company.
z. Viking Corporation.
aa. Watts Water Technologies, Inc.

3. Standard: UL 312.
4. Pressure Rating: 250 psig (1725 kPa) minimum.
5. Type: Swing check.
6. Body Material: Cast iron.
7. End Connections: Flanged or grooved.

C. Bronze OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Crane Co.; Crane Valve Group; Crane Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. United Brass Works, Inc.

3. Standard: UL 262.
4. Pressure Rating: 175 psig (1200 kPa).
5. Body Material: Bronze.
6. End Connections: Threaded.

D. Iron OS&Y Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. American Cast Iron Pipe Company; Waterous Company Subsidiary.
b. American Valve, Inc.
c. Clow Valve Company; a division of McWane, Inc.
d. Crane Co.; Crane Valve Group; Crane Valves.
e. Crane Co.; Crane Valve Group; Jenkins Valves.
f. Crane Co.; Crane Valve Group; Stockham Division.
g. Hammond Valve.
h. Milwaukee Valve Company.
i. Mueller Co.; Water Products Division.
j. NIBCO INC.
k. Shurjoint Piping Products.
l. Tyco Fire & Building Products LP.
m. United Brass Works, Inc.
n. Watts Water Technologies, Inc.

3. Standard: UL 262.
4. Pressure Rating: 250 psig (1725 kPa) minimum.
5. Body Material: Cast or ductile iron.
6. End Connections: Flanged or grooved.

E. Indicating-Type Butterfly Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Anvil International, Inc.
    b. Fivalco Inc.
    c. Global Safety Products, Inc.
    d. Kennedy Valve; a division of McWane, Inc.
    e. Milwaukee Valve Company.
    f. NIBCO INC.
    g. Shurjoint Piping Products.
    h. Tyco Fire & Building Products LP.
    i. Victaulic Company.

3. Standard: UL 1091.
4. Pressure Rating: 175 psig (1200 kPa) minimum.
5. Valves NPS 2 (DN 50) and Smaller:

    a. Valve Type: Ball or butterfly.
    b. Body Material: Bronze.
    c. End Connections: Threaded.

6. Valves NPS 2-1/2 (DN 65) and Larger:

    a. Valve Type: Butterfly.
    b. Body Material: Cast or ductile iron.
    c. End Connections: Flanged, grooved, or wafer.

2.5 HOSE CONNECTIONS

A. Adjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. Fire-End & Croker Corporation.
    d. Fire Protection Products, Inc.
    e. GMR International Equipment Corporation.

f. Guardian Fire Equipment, Inc.
g. Potter Roemer.
h. Tyco Fire & Building Products LP.
i. Wilson & Cousins Inc.
j. Zurn Plumbing Products Group; Wilkins Water Control Products Division.

3. Standard: UL 668 hose valve, with integral UL 1468 reducing or restricting pressure-control device, for connecting fire hose.
4. Pressure Rating: 300 psig (2070 kPa) minimum.
5. Material: Brass or bronze.
6. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
7. Inlet: Female pipe threads.
8. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
9. Pattern: Angle or gate.
10. Pressure-Control Device Type: Pressure reducing.
11. Design Outlet Pressure Setting: 175 psig (1200kPa).
12. Finish: Rough brass or bronze.

B. Nonadjustable-Valve Hose Connections:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. AFAC Inc.
b. Elkhart Brass Mfg. Company, Inc.
c. Fire-End & Croker Corporation.
d. Fire Protection Products, Inc.
e. GMR International Equipment Corporation.
f. Guardian Fire Equipment, Inc.
g. Kennedy Valve; a division of McWane, Inc.
h. Mueller Co.; Water Products Division.
i. NIBCO INC.
j. Potter Roemer.
k. Tyco Fire & Building Products LP.
l. Wilson & Cousins Inc.
m.

3. Standard: UL 668 hose valve for connecting fire hose.
4. Pressure Rating: 300 psig (2070 kPa) minimum.
5. Material: Brass or bronze.
6. Size: NPS 1-1/2 or NPS 2-1/2 (DN 40 or DN 65), as indicated.
7. Inlet: Female pipe threads.
8. Outlet: Male hose threads with lugged cap, gasket, and chain. Include hose valve threads according to NFPA 1963 and matching local fire-department threads.
9. Pattern: Angle or gate.
10. Finish: Rough brass or bronze.

2.6 FIRE-DEPARTMENT CONNECTIONS

A. Fire-Department Connection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. AFAC Inc.
    b. Elkhart Brass Mfg. Company, Inc.
    c. GMR International Equipment Corporation.
    d. Guardian Fire Equipment, Inc.
    e. Potter Roemer.

3. Standard: UL 405.
4. Type: for post mounting.
5. Pressure Rating: 175 psig (1200 kPa) minimum.
6. Body Material: Corrosion-resistant metal.
7. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
8. Caps: Brass, lugged type, with gasket and chain.
9. Escutcheon Plate: Rectangular, brass, wall type.
10. Outlet: With pipe threads.
11. Body Style: Vertical.
12. Number of Inlets: Three.
13. Outlet Location: Bottom.
14. Escutcheon Plate Marking: Similar to "STANDPIPE."
15. Finish: Rough brass or bronze.
16. Outlet Size: NPS 6 (DN 150).

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements in NFPA 14 for installation of fire-suppression standpipe piping.

C. Install seismic restraints on piping. Comply with requirements in NFPA 13 for seismic-restraint device materials and installation.

D. Install listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install drain valves on standpipes. Extend drain piping to outside of building.

F. Install hangers and supports for standpipe system piping according to NFPA 14. Comply with requirements in NFPA 13 for hanger materials.

G. Drain dry-type standpipe system piping.

H. Pressurize and check dry-type standpipe system piping.

I. Fill wet-type standpipe system piping with water.

J. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

K. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 210517 "Sleeves and Sleeve Seals for Fire-Suppression Piping."

L. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 210518 "Escutcheons for Fire-Suppression Piping."

3.2 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 (DN 50) and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 (DN 65) and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. 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.

H. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

I. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

J. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

K. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 14 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

3.4 HOSE-CONNECTION INSTALLATION

A. Install hose connections adjacent to standpipes.

B. Install freestanding hose connections for access and minimum passage restriction.

C. Install NPS 2-1/2 (DN 65) hose connections.

3.5 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install post-type, fire-department connections.

3.6 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 14.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
3. Coordinate with fire-alarm tests. Operate as required.
4. Verify that equipment hose threads are same as local fire-department equipment.

C. Fire-suppression standpipe system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.8 PIPING SCHEDULE

A. Dry-type, fire-suppression standpipe piping, shall be the following:

1. Standard-weight, galvanized-steel pipe with threaded ends; galvanized, gray-iron threaded fittings; and threaded joints.
2. Standard-weight, galvanized-steel pipe with cut-grooved ends; galvanized, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

END OF SECTION 21 12 00

SECTION 22 05 13 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with NEMA MG 1 unless otherwise indicated.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet (1000 m) above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split phase.

3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 22 05 13

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

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Bronze angle valves.
2. Brass ball valves.
3. Bronze ball valves.
4. Bronze swing checks valves.
5. Bronze gate valves.
6. Iron Gate valves.
7. Bronze globe valves.

B. Related Sections:

1. Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
2. Section 221423 "Storm Drainage Piping Specialties" for valves applicable only to this piping.
3. Section 334100 "Storm Utility Drainage Piping" for valves applicable only to this piping.
4. Section 334600 "Subdrainage" for valves applicable only to this piping.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

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-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.

E. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRASS BALL VALVES

A. Two-Piece, Full-Port, Brass Ball Valves with Brass Trim:

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. 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.

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.

2.3 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.

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.

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.

2.4 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.

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.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 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 check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Center-Guided and Plate-Type Check Valves: In horizontal or vertical position, between flanges.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, or gate valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes 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.

3.5 DOMESTIC COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 (DN 50) and Smaller:

1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, brass or bronze with brass, bronze or stainless-steel trim.
3. Bronze Swing Check Valves: Class 125, bronze disc.
4. Bronze Gate Valves: Class 125, NRS.

END OF SECTION 22 05 23

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. Fastener systems.
4. Pipe positioning systems.
5. 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.

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 ACTION SUBMITTALS

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

B. Shop Drawings: Signed and sealed by a qualified professional engineer. 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.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.5 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.

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 FASTENER SYSTEMS

A. 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.

2.4 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.

2.5 EQUIPMENT SUPPORTS

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

2.6 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.

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.

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.

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 Section 099113 "Exterior Painting." [Section 099123 "Interior Painting."

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 carbon-steel pipe hangers and supports and metal trapeze pipe hangers and attachments for general service applications.

E. Use padded hangers for piping that is subject to scratching.

F. 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.

G. 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.

H. 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.

I. 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-joist 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.

J. 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.

K. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

L. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

M. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 22 05 29

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

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. Isolation pads.
2. Isolation mounts.
3. Restrained elastomeric isolation mounts.
4. Freestanding and restrained spring isolators.
5. Housed spring mounts.
6. Elastomeric hangers.
7. Spring hangers.
8. Spring hangers with vertical-limit stops.
9. Pipe riser resilient supports.
10. Resilient pipe guides.
11. Seismic snubbers.
12. Restraining braces and cables.
13. Steel and inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

A. IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: A.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: I.

a. Component Importance Factor: 1.5.
b. Component Response Modification Factor: 2.5.
c. Component Amplification Factor: 2.5

3. Design Spectral Response Acceleration at Short Periods (0.2 Second):
4. Design Spectral Response Acceleration at 1-Second Period.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.

a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction].
b. Annotate to indicate application of each product submitted and compliance with requirements.

3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.
4. Seismic-Restraint Details:

a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacing's. Identify components, list their strengths, and indicate directions and values of forces transmitted to the

structure during seismic events. Indicate association with vibration isolation devices.

c. Preapproval and Evaluation Documentation: By an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.
4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

D. Pads : Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel base plates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

E. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with base plate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

F. Restrained Mounts: All-directional mountings with seismic restraint.

1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

G. Spring Isolators: Freestanding, laterally stable, open-spring isolators.

1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
2. Minimum Additional Travel: 50 percent of the required deflection at rated load.
3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

H. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.

1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
2. Restraint: Seismic or limit-stop as required for equipment and authorities having jurisdiction.
3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

I. Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.

1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint.
2. Base: Factory drilled for bolting to structure.
3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch (6-mm) travel up or down before contacting a resilient collar.

J. Elastomeric Hangers: Single or double-deflection type, fitted with molded, oil-resistant elastomeric isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range.

K. Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
7. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

L. Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
8. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

M. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

N. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

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. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Isolation Technology, Inc.
4. Kinetics Noise Control.
5. Mason Industries.
6. Vibration Eliminator Co., Inc.
7. Vibration Isolation.
8. Vibration Mountings & Controls, Inc.

D. Steel Base: Factory-fabricated, welded, structural-steel bases and rails.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

E. Inertia Base : Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.

1. Design Requirements: Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.

   a. Include supports for suction and discharge elbows for pumps.

2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 SEISMIC-RESTRAINT DEVICES

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. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti, Inc.
5. Kinetics Noise Control.
6. Loos & Co.; Cableware Division.
7. Mason Industries.
8. TOLCO Incorporated; a brand of NIBCO INC.
9. Unistrut; Tyco International, Ltd.

D. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

E. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

F. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

G. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

H. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

I. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

J. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

K. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

L. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

M. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:

1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).
3. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES an agency acceptable to authorities having jurisdiction] providing required submittals for component.

B. Piping Restraints:

1. Comply with requirements in MSS SP-127.
2. Space lateral supports a maximum of 40 feet (12 m)o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
3. Brace a change of direction longer than 12 feet (3.7 m).

C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an evaluation service member of ICC-ES providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment. Comply with requirements in Section 221116 "Domestic Water Piping" for piping flexible connections.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. Air-Mounting System Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
10. Air-Mounting System Operational Test: Test the compressed-air leveling system.
11. Test and adjust air-mounting system controls and safeties.
12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.7 PLUMBING VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE SCHEDULE

A. Supported or Suspended Equipment:

1. Equipment
2. Pads:

    a. Material: Neoprene.

END OF SECTION 22 05 48

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Stencils.
5. Valve tags.
6. Warning tags.

1.3 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch (0.8-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 or self-tapping screws.
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: Black.

C. Background Color: Yellow.

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 or 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 partially cover 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.

2.4 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch (19 mm) for access panel and door labels, equipment labels, and similar operational instructions.

1. Stencil Material: Aluminum.
2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch (6.4-mm) letters for piping system abbreviation and 1/2-inch (13-mm) numbers.

1. Tag Material: Brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or

modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.6 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

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 Section 099600 "High-Performance Coatings."

B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels with painted, color-coded bands or rectangles, complying with ASME A13.1, on each piping system.

1. Identification Paint: Use for contrasting background.
2. Stencil Paint: Use for pipe marking.

C. 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 25 feet (7.6 m)] along each run. Reduce intervals to 15 feet (4.6 m)in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

D. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:

2. Domestic Water Piping:

   a. Background Color: Yellow.
   b. Letter Color: Black.

3. Storm Drainage Piping:

   a. Background Color: Blue.
   b. Letter Color: Black.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 2 inches (50 mm), round.

2. Valve-Tag Color:

   a. Cold Water: Green

3. Letter Color:

   a. Cold Water: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 11 16 - DOMESTIC AND RECLAIM WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Under-building-slab and aboveground domestic and reclaim water pipes, tubes, and fittings inside buildings.
2. Encasement for piping.

B. Related Requirements:

1. Section 221113 "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.

1.3 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.

B. Field quality-control reports.

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

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.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.

B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.

C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

F. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Solder Filler Metals: ASTM B 32, lead-free alloys.

C. Flux: ASTM B 813, water flushable.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

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

B. Form: tube.

C. Color: natural.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
2. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:

a. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.

c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

3. Standard: ASSE 1079.
4. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
5. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Matco-Norca.
d. Watts; a division of Watts Water Technologies, Inc.
e. Wilkins; a Zurn company.

3. Standard: ASSE 1079.
4. Factory-fabricated, bolted, companion-flange assembly.
5. Pressure Rating: 125 psig (860 kPa) minimum at 180 deg F (82 deg C).
6. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Central Plastics Company.
d. Pipeline Seal and Insulator, Inc.

3. Nonconducting materials for field assembly of companion flanges.
4. Pressure Rating: 150 psig (1035 kPa).
5. Gasket: Neoprene or phenolic.
6. Bolt Sleeves: Phenolic or polyethylene.
7. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Elster Perfection Corporation.
    b. Grinnell Mechanical Products; Tyco Fire Products LP.
    c. Matco-Norca.
    d. Precision Plumbing Products, Inc.
    e. Victaulic Company.

3. Standard: IAPMO PS 66.
4. Electroplated steel nipple complying with ASTM F 1545.
5. Pressure Rating and Temperature: 300 psig (2070 kPa) at 225 deg F (107 deg C).
6. End Connections: Male threaded or grooved.
7. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic and reclaim 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 CGA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install underground copper tube in PE encasement according to ASTM A 674 or AWWA C105/A21.5.

E. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic and reclaim water-service entrance. Comply with requirements for strainers in Section 221119 "Domestic Water Piping Specialties."

F. Install shutoff valve immediately upstream of each dielectric fitting.

G. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."

H. Install domestic and reclaim water piping level with 0.25 percent slope downward toward drain and plumb.

I. Rough-in domestic and reclaim water piping for water-meter installation according to utility company's requirements.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

L. 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.

M. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

N. Install piping to permit valve servicing.

O. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

P. Install piping free of sags and bends.

Q. Install fittings for changes in direction and branch connections.

R. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

S. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "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 for Copper Tubing: Comply with CGA's "Copper Tube Handbook," "Brazed Joints" chapter.

E. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CGA's "Copper Tube Handbook."

F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic and reclaim water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.4 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic and Reclaim Water Piping:

1. Fittings for NPS 1-1/2 (DN 40) and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 (DN 50) and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic and Reclaim Water Piping NPS 2 (DN 50) and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 (DN 50) and smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    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. 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.

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.

H. Install supports for vertical steel piping every 15 feet (4.5 m).

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic and reclaim water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic and reclaim water piping to water-service piping with shutoff valve; extend and connect to the following:
   1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
   2. 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.

3.8 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

C. All reclaim water piping and fittings shall be continuously wrapped with purple-colored mylar tape.

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

   1. Piping Inspections:

      a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
      b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

         1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
         2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

      c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic and reclaim water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic and reclaim water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
d. Cap and subject piping to static water pressure of 50 psig (345 kPa) above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic and reclaim water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 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. Repeat procedures if biological examination shows contamination.
    e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic and reclaim water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic and reclaim water piping system. Remove dirt and debris as work progresses.

3.12 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.

C. Under-building-slab, domestic and reclaim water, building-service piping, NPS 3 (DN 80) and smaller, shall be the following:

1. Soft copper tube, ASTM B 88, Type K (ASTM B 88M, Type A); wrought-copper, solder-joint fittings; and brazed joints.

D. Aboveground domestic and reclaim water piping, NPS 2 (DN 50) and smaller, shall be the following:
1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); cast- or wrought-copper, solder-joint fittings; and soldered joints.

3.13 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. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic and reclaim water flow to and from equipment.

END OF SECTION 22 11 16

SECTION 22 11 19 – DOMESTIC AND RECLAIM WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Hose bibbs.
4. Wall hydrants.
5. Ground hydrants.
6. Post hydrants.
7. Drain valves.
8.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For domestic and reclaim water piping specialties.

1. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic and reclaim water piping specialties to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14.

2.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water & Reclaim Piping and Specialties: 125 psig (860 kPa) unless otherwise indicated.

2.3 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. Conbraco Industries, Inc.
    d. FEBCO; a division of Watts Water Technologies, Inc.
    e. Rain Bird Corporation.
    f. Toro Company (The); Irrigation Div.
    g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
    h. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

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. Manufacturers: Subject to compliance with requirements, provide products by 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. Arrowhead Brass Products.
    b. Cash Acme; a division of Reliance Worldwide Corporation.
    c. Conbraco Industries, Inc.

d. Legend Valve.
e. MIFAB, Inc.
f. Prier Products, Inc.
g. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
h. Woodford Manufacturing Company; a division of WCM Industries, Inc.
i. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
j. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

3. Standard: ASSE 1011.
4. Body: Bronze, nonremovable, with manual drain.
5. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
6. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Flomatic Corporation.
e. Toro Company (The); Irrigation Div.
f. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
g. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

3. Standard: ASSE 1020.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 5 psig (35 kPa) maximum, through middle third of flow range.
6. Accessories:

a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers :

1. Manufacturers: Subject to compliance with requirements, provide products by 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. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.

b. Conbraco Industries, Inc.
c. FEBCO; a division of Watts Water Technologies, Inc.
d. Flomatic Corporation.
e. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
f. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.

3. Standard: ASSE 1013.
4. Operation: Continuous-pressure applications.
5. Pressure Loss: 12 psig (83 kPa) maximum, through middle third of flow range.
6. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved.
7. End Connections: Threaded for NPS 2 (DN 50) and smaller.
8. Configuration: Designed for horizontal, straight-through flow.
9. Accessories:

a. Valves NPS 2 (DN 50) and Smaller: Ball type with threaded ends on inlet and outlet.
b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

2.5 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: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.6 WALL HYDRANTS

A. Moderate-Climate Wall Hydrants :

1. Manufacturers: Subject to compliance with requirements, provide products by 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. 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.
    g. Woodford Manufacturing Company; a division of WCM Industries, Inc.
    h. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
    i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

3. Standard: ASME A112.21.3M for conceal-outlet, self-draining wall hydrants.
4. Pressure Rating: 125 psig (860 kPa).
5. Operation: Loose key.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet:

    a. Concealed, with integral vacuum breaker or nonremovable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7.

8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet:

    a. Concealed, with integral vacuum breaker or non removable hose-connection vacuum breaker complying with ASSE 1011 or backflow preventer complying with ASSE 1052.
    b. Garden-hose thread complying with ASME B1.20.7.

11. Nozzle and Wall-Plate Finish: Rough bronze.
12. Operating Keys(s): Two with each wall hydrant.

2.7 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.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4 (DN 20).
4. Body: ASTM B 62 bronze.
5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.8 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by 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. AMTROL, Inc.
b. Josam Company.
c. MIFAB, Inc.
d. Precision Plumbing Products, 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.
i. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.

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.

PART 3 - EXECUTION

3.1 ICONNECTIONS

A. Comply with requirements for ground equipment in Section 260526 "Grounding and Bonding for Electrical Systems."

B. Fire-retardant-treated-wood blocking is specified in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical connections.

3.2 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.

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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.3 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Domestic and reclaim water piping specialties will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 22 11 19

SECTION 22 13 23 - SANITARY WASTE INTERCEPTORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Clarifier interceptors.

1.3 DEFINITIONS

A. FRP: Fiberglass-reinforced plastic.

B. PP: Polypropylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of interceptor indicated. Include materials of fabrication, dimensions, rated capacities, retention capacities, operating characteristics, size and location of each pipe connection, furnished specialties, and accessories.

B. Shop Drawings: For each type and size of precast-concrete interceptor indicated.

1. Include materials of construction, dimensions, rated capacities, retention capacities, location and size of each pipe connection, furnished specialties, and accessories.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Interceptors, drawn to scale, on which the following items are shown and coordinated with each other, based on input from Installers of the items involved:

1. Interceptors.
2. Piping connections. Include size, location, and elevation of each.
3. Interface with underground structures and utility services.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Storm Sewer Services: Do not interrupt services to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary sewer services according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of service.
2. Do not proceed with interruption of storm sewer services without Architect's written permission.

PART 2 - PRODUCTS

2.1 CLARIFIER INTERCEPTORS

A. Clarifier Interceptors: Precast concrete complying with ASTM C 913.

1. Include rubber-gasketed joints, vent connections, manholes, compartments or baffles, and piping or openings to retain oils and debris and to permit wastewater flow.
2. Structural Design Loads:
   a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
   b. Walkway Load: Comply with ASTM C 890, A-03.
3. Resilient Pipe Connectors: ASTM C 923 (ASTM C 923M), cast or fitted into interceptor walls, for each pipe connection.
4. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals. Omit steps if total depth from floor of interceptor to finished grade is less than 60 inches (1500 mm).
5. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, to match diameter of manhole frame and cover.
6. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.
   a. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
   b. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
   c. Include indented top design with lettering cast into cover, using wording equivalent to "CLARIFIER"

B. Capacities and Characteristics: As shown in drawings

1. Length by Width by Depth: <Insert inches (mm)>.

2.2 PRECAST-CONCRETE MANHOLE RISERS

A. Precast-Concrete Manhole Risers: ASTM C 478 (ASTM C 478M), with rubber-gasket joints.

1. Structural Design Loads:
   a. Heavy-Traffic Load: Comply with ASTM C 890, A-16 (ASSHTO HS20-44).
   b. Walkway Load: Comply with ASTM C 890, A-03.
2. Length: From top of underground concrete structure to grade.
3. Riser Sections: 3-inch (75-mm) minimum thickness and 36-inch (915-mm) diameter.
4. Top Section: Eccentric cone, unless otherwise indicated. Include top of cone to match grade ring size.
5. Gaskets: ASTM C 443 (ASTM C 443M), rubber.
6. Steps: Individual FRP steps or FRP ladder, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12- to 16-inch (300- to 400-mm) intervals.

B. Grade Rings: Reinforced-concrete rings, 6- to 9-inch (150- to 225-mm) total thickness, diameter matching manhole frame and cover, and height as required to adjust the manhole frame and cover to indicated elevation and slope.

C. Manhole Frames and Covers: Ferrous; 24-inch (610-mm) ID by 7- to 9-inch (175- to 225-mm) riser with 4-inch- (100-mm-) minimum width flange and 26-inch- (660-mm-) diameter cover.

1. Ductile Iron: ASTM A 536, Grade 60-40-18, unless otherwise indicated.
2. Gray Iron: ASTM A 48, Class 35, unless otherwise indicated.
3. Include indented top design with lettering cast into cover, using wording equivalent to the following:
   a. Clarifier Interceptors in Storm Sewerage System: "CLARIFIER"

PART 3 - EXECUTION

3.1 EARTHWORK

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

3.2 INSTALLATION

A. Install precast-concrete interceptors according to ASTM C 891. Set level and plumb.

B. Install manhole risers from top of underground concrete interceptors to manholes and gratings at finished grade.

C. Set tops of manhole frames and covers flush with finished surface in pavements. Set tops 3 inches (75 mm) above finish surface elsewhere, unless otherwise indicated.

D. Set tops of grating frames and grates flush with finished surface.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 221413 "Facility Storm Drain Piping". Drawings indicate general arrangement of piping, fittings, and specialties.

B. Make piping connections between interceptors and piping systems.

3.4 IDENTIFICATION

A. Identification materials and installation are specified in Section 312000 "Earth Moving." Arrange for installation of green warning tapes directly over piping and at outside edges of underground interceptors.

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.

END OF SECTION 22 13 23

SECTION 22 14 13 - FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.
3. Encasement for underground metal piping.

B. Related Sections:

1. Section 221429 "Sump Pumps" for storm drainage pumps.
2. Section 334100 "Storm Utility Drainage Piping" for storm drainage piping outside the building.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Storm Drainage Piping: 10-foot head of water (30 kPa).

B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

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

B. Shop Drawings: For roof drainage system. Include calculations, plans, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

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

B. Comply with NSF/ANSI 14, "Plastics Piping System Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic drain piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Storm-Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect no fewer than seven days in advance of proposed interruption of storm-drainage service.

2. Do not proceed with interruption of storm-drainage service without Architect's written permission.

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 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ANACO-Husky.
b. Dallas Specialty & Mfg. Co.
c. Fernco Inc.
d. Matco-Norca, Inc.
e. MIFAB, Inc.
f. Mission Rubber Company; a division of MCP Industries, Inc.
g. Stant.
h. Tyler Pipe.

2. Standards: ASTM C 1277 and CISPI 310.

3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. ANACO-Husky.
b. Clamp-All Corp.
c. Dallas Specialty & Mfg. Co.
d. MIFAB, Inc.
e. Mission Rubber Company; a division of MCP Industries, Inc.
f. Stant.
g. Tyler Pipe.

2. Standards: ASTM C 1277 and ASTM C 1540.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

D. Cast-Iron, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. MG Piping Products Company.
b. Or approved equal.

2. Standard: ASTM C 1277.

3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.

2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.

3. Unshielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Dallas Specialty & Mfg. Co.
      2) Fernco Inc.
      3) Mission Rubber Company; a division of MCP Industries, Inc.
      4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.
   b. Standard: ASTM C 1173.
   c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
   d. Sleeve Materials:
      1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
      2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
         a) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

4. Shielded, Nonpressure Transition Couplings:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Cascade Waterworks Mfg. Co.
      2) Mission Rubber Company; a division of MCP Industries, Inc
   b. Standard: ASTM C 1460.
   c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Capitol Manufacturing Company.
      2) Central Plastics Company.
      3) Hart Industries International, Inc.
      4) Jomar International Ltd.
      5) Matco-Norca, Inc.
      6) McDonald, A. Y. Mfg. Co.
      7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      8) Wilkins; a Zurn company.
   b. Description:
      1) Standard: ASSE 1079.

2) Pressure Rating: 150 psig (1035 kPa) at 180 deg F (82 deg C).
3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Capitol Manufacturing Company.
      2) Central Plastics Company.
      3) Matco-Norca, Inc.
      4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      5) Wilkins; a Zurn company.
   b. Description:
      1) Standard: ASSE 1079.
      2) Factory-fabricated, bolted, companion-flange assembly.
      3) Pressure Rating: 150 psig (1035 kPa).
      4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:
   a. M Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Advance Products & Systems, Inc.
      2) Calpico, Inc.
      3) Central Plastics Company.
      4) Pipeline Seal and Insulator, Inc.
   b. Description:
      1) Nonconducting materials for field assembly of companion flanges.
      2) Pressure Rating: 150 psig (1035 kPa).
      3) Gasket: Neoprene or phenolic.
      4) Bolt Sleeves: Phenolic or polyethylene.
      5) Washers: Phenolic with steel-backing washers.

5. Dielectric Nipples:
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Elster Perfection.
      2) Grinnell Mechanical Products.
      3) Matco-Norca, Inc.
      4) Precision Plumbing Products, Inc.
      5) Victaulic Company.
   b. Description:
      1) Electroplated steel nipple complying with ASTM F 1545.
      2) Pressure Rating: 300 psig (2070 kPa) at 225 deg F (107 deg C).
      3) End Connections: Male threaded or grooved.
      4) Lining: Inert and noncorrosive, propylene.

2.4 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 674 or AWWA C105.

B. Material: High-density, crosslaminated PE film of 0.004-inch (0.10-mm) or LLDPE film of 0.008-inch (0.20-mm) minimum thickness.

C. Form: Sheet or tube.

D. Color: Black or natural].

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. 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 from layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. 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.

L. Lay buried building storm 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.

M. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 2 percent downward in direction of flow for piping NPS 4 (DN 100) and larger.
2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

O. Plumbing Specialties:

1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."

P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Hubless, Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

B. 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.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Unshielded, nonpressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 (DN 50) and Smaller: Use dielectric unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Use dielectric flange kits.
4. Dielectric Fittings for NPS 5 (DN 125) and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint as required by CPC.

B. Comply with requirements for pipe hanger and support devices and installation as required CPC.

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

2. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.

3. Vertical Piping: MSS Type 8 or Type 42, clamps.

4. Individual, Straight, Horizontal Piping Runs:
   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.

5. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

6. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one 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 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4-inch (19-mm) rod.

5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8-inch (22-mm) rod.

6. Spacing for 10-foot (3-m) pipe 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).

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.

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.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

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.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground and underground storm drainage piping NPS 6 (DN 150) and smaller shall be the following:

1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

C. Aboveground and underground storm drainage piping NPS 8 (DN 200) and larger shall the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.

END OF SECTION 22 14 13

SECTION 22 14 29 - SUMP PUMPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Submersible sump pumps.
2. Wet-pit-volute sump pumps.
3. Sump-pump basins and basin covers.

1.2 ACTION SUBMITTALS

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

B. Wiring Diagrams: For power, signal, and control wiring.

1.3 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

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. UL Compliance: Comply with UL 778 for motor-operated water pumps.

PART 2 - PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

A. Submersible, Fixed-Position, Single-Seal Sump Pumps:

1. Manufacturers: Subject to compliance with requirements, provide products by one of 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. Barnes; Crane Pumps & Systems.

b. Bell & Gossett Domestic Pump; ITT Corporation.
c. Goulds Pumps; ITT Corporation.
d. Grundfos Pumps Corp.
e. Little Giant Pump Co.
f. Weil Pump Company, Inc.
g. Weinman Division; Crane Pumps & Systems.
h. Zoeller Company.

3. Description: Factory-assembled and -tested sump-pump unit.
4. Pump Type: Submersible, end-suction, single-stage, close-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.
5. Pump Casing: Cast iron, with strainer inlet, legs that elevate pump to permit flow into impeller, and vertical discharge for piping connection.
6. Impeller: Statically and dynamically balanced, ASTM B 584, cast bronze, semiopen design for clear wastewater handling, and keyed and secured to shaft.
7. Pump and Motor Shaft: Stainless steel, with factory-sealed, grease-lubricated ball bearings.
8. Seal: Mechanical.
9. Motor: Hermetically sealed, capacitor-start type; with built-in overload protection; lifting eye or lug; and three-conductor, waterproof power cable of length required and with grounding plug and cable-sealing assembly for connection at pump.

    a. Motor Housing Fluid: Oil.

10. Controls:

    a. Enclosure: NEMA 250, Type 4X.
    b. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
    c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    d. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
    e. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

11. Controls:

    a. Enclosure: NEMA 250, Type 4X; wall-mounted.
    b. Switch Type: Mercury-float type, in NEMA 250, Type 6 enclosures with mounting rod and electric cables.
    c. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
    d. High-Water Alarm: Rod-mounted, NEMA 250, Type 6 enclosure with mercury-float, switch matching control and electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

12. Control-Interface Features:

    a. Remote Alarm Contacts: For remote alarm interface.

b. Building Automation System Interface: Auxiliary contacts in pump controls for interface to building automation system and capable of providing the following:

1) On-off status of pump.
2) Alarm status.

2.2 WET-PIT-VOLUTE SUMP PUMPS

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 product indicated on Drawings or comparable product by one of the following:

1. Armstrong Pumps Inc.
2. Chicago Pump Company; a division of Yeomans Chicago Corporation.
3. PACO Pumps; Grundfos Pumps Corporation, U.S.A.
4. Peerless Pump, Inc.
5. Swaby Manufacturing Company.
6. Weil Pump Company, Inc.
7. Weinman Division; Crane Pumps & Systems.

C. Description: Factory-assembled and -tested sump-pump unit.

D. Pump Type: Wet-pit-volute, single-stage, separately-coupled, overhung-impeller, centrifugal sump pump as defined in HI 1.1-1.2 and HI 1.3.

E. Pump Casing: Cast iron, with strainer inlet and threaded connection for NPS 2 (DN 50) and smaller and flanged connection for NPS 2-1/2 (DN 65) and larger discharge piping.

F. Impeller: Statically and dynamically balanced, ASTM B 584, cast bronze, semiopen design for clear wastewater handling, and keyed and secured to shaft.

G. Sleeve Bearings: Bronze. Include oil-lubricated, intermediate sleeve bearings at 48-inch (1200-mm) maximum intervals if basin depth is more than 48 inches (1200 mm), and grease-lubricated, ball-type thrust bearings.

H. Pump and Motor Shaft Coupling: Flexible, capable of absorbing torsional vibration and shaft misalignment.

I. Pump Discharge Piping: Factory or field fabricated, galvanized, ASTM A 53/A 53M, Schedule 40, steel pipe with ASME B16.1, Class 125, cast-iron flanges and flanged fittings or ASME B16.4, Class 125, gray iron threaded fittings.

J. Support Plate: Cast iron or coated steel and strong enough to support pumps, motors, and controls. Refer to Part 2 "Sump-Pump Basins and Basin Covers" Article for requirements.

K. Shaft Seal: Stuffing box, with graphite-impregnated braided-yarn rings and bronze packing gland.

L. Motor: Single-speed; grease-lubricated ball bearings and mounting on vertical, cast-iron pedestal.

M. Controls:

1. Enclosure: NEMA 250, Type 4X.
2. Switch Type: Pedestal-mounted float switch with float rods and rod buttons.
3. Automatic Alternator: Start pumps on successive cycles and start multiple pumps if one cannot handle load.
4. Float Guides: Pipe or other restraint for floats and rods in basins of depth greater than 60 inches (1500 mm).
5. High-Water Alarm: Cover-mounted, compression-probe alarm, with electric bell; 120-V ac, with transformer and contacts for remote alarm bell.

2.3 SUMP-PUMP BASINS AND BASIN COVERS

A. Basins: Factory-fabricated, watertight, cylindrical, basin sump with top flange and sidewall openings for pipe connections.

1. Material: Fiberglass.
2. Reinforcement: Mounting plates for pumps, fittings, and accessories.
3. Anchor Flange: Same material as or compatible with basin sump, cast in or attached to sump, in location and of size required to anchor basin in concrete slab.

B. Basin Covers: Fabricate metal cover with openings having gaskets, seals, and bushings; for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.

1. Reinforcement: Steel or cast iron, capable of supporting foot traffic for basins installed in foot-traffic areas.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

B. Motors for submersible pumps shall be hermetically sealed.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation and filling are specified in Section 312000 "Earth Moving."

3.2 INSTALLATION

A. Pump Installation Standard: Comply with HI 1.4 for installation of sump pumps.

END OF SECTION 22 14 29

SECTION 23 81 13 - PACKAGED TERMINAL AIR-CONDITIONERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes packaged terminal air conditioners and their accessories and controls, in the following configurations:

1. Through-the-wall air conditioners.
2. Cooling-only units.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For packaged terminal air conditioners. Include plans, elevations, sections, details for wall penetrations, seismic bracing, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Color Samples: For unit cabinet, discharge grille, and exterior louver, and for each color and texture specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged terminal air conditioners that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Sealed Refrigeration System: Manufacturer's standard, but not less than [5] five years from date of Substantial Completion, including components and labor.
2. Warranty Period for Nonsealed System Parts: Manufacturer's standard, but not less than [1] one year from date of Substantial Completion, including only components and excluding labor.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer's: Subject to compliance with requirements, provide Friedrich Air Conditioning Co. or product similar in design, construction, and performance by one of the following:

1. Carrier Corporation; a United Technologies company.
2. ClimateMaster, Inc.
3. General Electric Company; GE Consumer & Industrial - Appliances.
4. McQuay International.
5. Trane; a business of American Standard Companies.

2.2 MANUFACTURED UNITS

A. Description: Factory-assembled and -tested, self-contained, packaged terminal air conditioner with room cabinet, electric refrigeration system, and temperature controls; fully charged with refrigerant and filled with oil; with chassis.

2.3 CHASSIS

A. Cabinet: removable front panel with concealed latches.

1. Mounting: Wall with wall sleeve
2. Discharge Grille: discharge grille allowing upward and horizontal airflow.
3. Louvers: Extruded aluminum with enamel finish. White color.

4. Finish: Baked enamel.
5. Access Door: Hinged door in top of cabinet for access to controls.
6. Cabinet Extension: Matching cabinet in construction and finish, allowing diversion of airflow to adjoining room; with grille.
7. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
8. Wall Sleeves: Galvanized steel with polyester finish.

B. Refrigeration System: Direct-expansion indoor coil with capillary restrictor; and hermetically sealed scroll compressor with vibration isolation and overload protection.

1. Indoor and Outdoor Coils: Seamless copper tubes mechanically expanded into aluminum fins.
2. Accumulator.
3. Constant-pressure expansion valve.

C. Indoor Fan: Forward curved, centrifugal; with motor and positive-pressure ventilation damper with electric operator.

D. Filters: Washable polyurethane in molded plastic frame.

E. Condensate Drain: Drain pan and piping to direct condensate to building waste and vent piping.

1. Comply with ASHRAE 62.1 for drain pan construction and connections.

2.4 CONTROLS

A. Remote Control: Standard unit-mounted controls with remote-mounted, low-voltage adjustable thermostat with heat-off-cool-auto, heat-off-cool switch, and on-auto fan switch.

2.5 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Factory test to comply with ARI 300, "Sound Rating and Sound Transmission Loss of Packaged Terminal Equipment."

B. Unit Performance Ratings: Factory test to comply with ARI 310/380/CSA C744, "Packaged Terminal Air-Conditioners and Heat Pumps."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units level and plumb, maintaining manufacturer's recommended clearances and tolerances.

B. Install wall sleeves in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Section 079200 "Joint Sealants."

C. Install and anchor wall sleeves to withstand, without damage to equipment and structure, seismic forces required by building code.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing packaged terminal air conditioners and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Packaged terminal air conditioners will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 23 81 13

SECTION 26 05 00 - BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Divisions 00 and 01 Specification Sections, apply to this Section and to all Sections of Divisions 26, 27 and 28.

1.2 SUMMARY

A. This Section includes the following:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Common electrical installation requirements.

1.3 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Refer to Division 01 for procedure.

B. Coordinated Shop Drawings, Product Data, Samples, and Certificates of Compliance: Submit as required by Contract Documents for each type of product indicated.

C. If the equipment submitted under Divisions 26, 27 and 28 requires changes in material or labor from that required in the contract plans and Specifications, all such changes shall be clearly indicated and submitted as shop drawings.

D. Contractor Responsibility: Corrections or comments made on the Shop Drawings during review do not relieve the Contractor from compliance with requirements of the Drawings and Specifications. Shop Drawing checking by the Engineer is only for review of general conformance with the design concept of the

project and general compliance with the information given in the Contract Documents. The Contractor is responsible for:

1. Confirming and correlating all quantities and dimensions.
2. Selecting fabrication processes and techniques of construction.
3. Coordinating his Work with all other trades.
4. Performing his Work in a safe and satisfactory manner.
5. Nomenclature, legend, symbols, and abbreviations on submitted material shall be same as used in Contract Documents.

E. Operating Instructions, Maintenance Manuals, and Parts Lists: Refer to Division 01 for requirements.

1.5 SERVICE MANUALS

A. Upon completion of the installation, and as a condition of its acceptance, prepare and submit an Operating and Maintenance Manual to the Owner for approval. The Contractor shall compile the manual from information supplied by equipment manufacturers. Each manual shall contain:

1. Complete instructions on the operation of all electrical equipment, including all control settings, switch positions, timer operation, etc.
2. Complete instructions regarding the maintenance of all electrical equipment including periods and frequencies of all inspections, lubricants required; and exact description of performance of such maintenance and full description of inspections and corrections to make a step-by-step basis.
3. Copy of all control and wiring diagrams.
4. Complete nomenclature of all replaceable parts, their part numbers, and the name and address of the nearest vendor.
5. Copy of all guarantees and warranties issued for components of the systems, showing all dates of expiration. Such dates shall not be sooner than the expiration of the completed installation guarantee specified herein.
6. Name, address and telephone number of the Contractor and each subcontractor employed for work under Divisions 26, 27 and 28.

B. Submit 3 copies of manuals in hardback binders.

1.6 RECORD DRAWINGS

A. Refer to General and Supplementary Conditions and Division 01 Specification Sections for additional requirements.

B. Two complete sets of hard copy electrical drawings and an electronic file (CD) in AutoCad shall be provided as record drawings, which shall be separate, clean,

prints reserved for the purpose of showing a complete picture of the work as actually installed.

C. Reproducible Drawings:

1. At the completion of his work, the Contractor shall secure, at his cost, a set of reproducible prints of the contract drawings and shall copy his record "as installed" data thereon.
2. The Contractor shall certify to the completeness and accuracy of the "as installed" information indicated on the reproducible prints with his signature.
3. On or before the date of the final inspection, the set of reproducible prints along with one print thereof and one set of the marked-up "Record Drawings" shall be delivered to the Owner.
4. These drawings shall be for record purposes for owner's use and are not considered Shop Drawings.

1.7 REQUESTS FOR INFORMATION (RFIS)

A. If in the opinion of the Design Team (Architect/Engineer) the RFIs submitted by the Contractor are being used as a substitute for the Contractor's review and understanding of the Contract, Contractor agrees to reimburse the Design Team for the time expended on the Contractor's RFIs, at the rate of $100 per hour. The same charges will accumulate for the extra effort for late RFIs and RFIs marked as priority. Said charges shall be backcharged as they are incurred as an unilateral change order to the Contract and deducted from the amount due or that may become due to Contractor.

1.8 QUALITY ASSURANCE

A. Refer to Division 01 for additional requirements.

B. Manufacturer: All equipment and accessories to be the product of a manufacturer regularly engaged in its manufacture. All items of a given type shall be the products of the same manufacturer.

C. UL Label: Supply all equipment and accessories new, free from defects and listed by Underwriters' Laboratories, Inc. or bearing its label.

D. Compliance: Supply all equipment and accessories in compliance with the applicable standards and with applicable national, state, and local codes.

E. Qualifications and Staffing: Refer to Division 01 for additional requirements.

F. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.9 JOB CONDITIONS

A. Drawings: Refer to Division 01 for additional requirements.

1. Electrical layouts are generally diagrammatic and, although size and location of equipment is drawn to scale wherever possible, Contractor shall make use of all data in Contract Documents and verify this information at building site.

2. Locations of items on the drawings may be distorted for purposes of clearness and legibility. Confirm the actual locations of architectural and mechanical items before proceeding with the Work.

3. Contractor shall adjust locations of light fixtures in mechanical rooms to compensate for changes in duct routing, to provide reasonably uniform lighting in work areas.

4. Outlets shall be located in accordance with architectural design, and specific locations may be determined by the Architect at jobsite prior to installation.

5. Outlets located on architectural plans by dimension shall be held. Additional outlets may be shown on electrical plans and shall be installed as close as practical to the location shown.

6. Manufacturers' drawings and instructions shall be followed in all cases where the makers of devices and equipment furnish directions, where details are not shown on the Drawings, or where described in the Specifications.

7. Work installed in a manner contrary to that shown in the contract documents shall be removed and reinstalled when so directed by the Architect. Discrepancies and questionable points shall be immediately reported to the Architect for clarification.

8. The Architect reserves the right to make reasonable changes in outlet locations prior to roughing-in at no additional cost to Owner.

B. Architect Interpretation: If any part of Specifications or Drawings appears unclear or contradictory, the Contractor shall submit a request for information to the Architect as early as possible, including during bidding period. Do not proceed with such Work without a formal response from the Architect.

C. Drawings and Specifications: Examine all Drawings and Specifications in a manner to be fully cognizant of all work Required under Divisions 26, 27 and 28.

D. Adjoining Work: Adjoining Work of other Divisions shall be examined for interferences and conditions affecting Divisions 26, 27 and 28.

1.10 SURVEY OF SITE

A. Before submitting proposals for this work, each bidder shall be familiar with plans and Specifications of all related trades, and shall have examined the bid drawings and the premises in detail and understood the conditions under which he will be obliged to operate in perform his contract. If a bidder feels that there is a conflict between the conditions shown on the drawings and the existing site,

the bidder shall bring this conflict to the owner prior to bid date. Once a bid is awarded, the owner will assume that there will be no major conflict arising during construction.

B. No allowance will be made in this connection, on behalf of the Contractor, for any error through negligence on his part to familiarize himself as specified.

1.11 COORDINATION

A. Generate fully coordinated shop drawings prior to installation.

B. Coordinate electrical requirements of other trades such as, but not limited to, Divisions 21, 22, and 23.

C. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

D. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

E. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08.

F. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.12 MOUNTING HEIGHTS

A. Mounting Heights of Devices and Equipment: Mounting heights of devices and equipment shown on the Drawings shall govern, but in the absence of such indications, the following centerline heights above the finished floor shall be maintained:

1. Wall switches: 4'-0"
2. Wall lights (interior): 7'-0"
3. Pendant or chain hung fixture: 10'-0"

4. Convenience receptacles:	18", except in Toilets and over cabinets or counter where the devices shall be mounted at 3'-6".
5. Telephone/Data outlets:	18” above finished floor.
6. Panelboard cabinets:	Shall be installed with the top6'-6" above floor for cabinets more than 2'-6" high and 6'-0" for cabinets less than 2'-6" high.

1.13 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. General: Check dimensions of access route through the site from delivery point to the final location. Where necessary, ship in crated sections of size to permit passing through available space. Dismantle and/or reassemble, reprovision and retest equipment too large to pass through available access route to final location in one piece.

B. Shipping and Handling: Ship equipment in original packages, to prevent damaging or entrance of foreign matter. Handle and ship in accordance with manufacturer's recommendations.

C. Protection: Provide protective coverings during construction.

D. Replacement: Replace at no expense to Owner, equipment or material damaged during storage or handling, as directed by the Architect.

E. Equipment Identification: Tag items with weatherproof tag, identifying equipment by name and purchase order number.

F. Packing and Shipping Lists: Include packing and shipping lists.

G. Special Requirements: As specified in individual Sections.

H. Refer to Division 01 for additional requirements.

1.14 SEISMIC RESTRAINTS

A. General: Provide seismic restraints per applicable code and as specified and/or indicated. Design and provide restraints to prevent permanent displacement in any direction caused by lateral motion, overturning or uplift.

B. Requirements:

1. Seismic Force Criteria: Per CAC Title 24 requirements.
    a. Equipment and Apparatus:
        1) Panelboards.
        2) Starters, including those furnished under other Sections.
        3) Lighting fixtures.

C. Equipment: If required to be restrained, the equipment itself must be designed to withstand required seismic force criteria, including its internal design, components and frame; and must have suitable structural elements to which restraining attachments may be fastened.

D. Rigidly Supported Equipment: Restrain per SMACNA guidelines where applicable; where not applicable restrain similarly and as recommended by the manufacturer of equipment.

E. Lighting Fixtures in Suspended Ceilings: Fixtures shall be attached to ceiling grid system or otherwise be supported from the structural floor above ceiling as approved by applicable codes or authorities.

F. Design:

1. Prepare designs, including arrangements, sizes, and model numbers indicated or referenced in applicable standards.

2. Where restraint designs, etc., are neither indicated nor referenced for items shown or selected for the project, prepare such designs, together with supporting calculations prepared by a duly licensed civil or structural engineer registered in the State of California. Submit details and calculations to the Structural Engineer of Record.

1.15 PROTECTION OF MATERIALS

A. Protection: Protect from damage, water, dust, etc., material, equipment, and apparatus provided under Divisions 26, 27 and 28, both in storage and installed, until Notice of Completion has been filed.

B. Temporary Storage Facilities: Provide temporary storage facilities for material and equipment.

C. Damage: Material, equipment or apparatus damaged because of improper storage or protection will be rejected. Remove from site and provide new, duplicate, material equipment, or apparatus in replacement of that rejected.

D. Motors and Moving Machinery: Cover motors and other moving machinery to protect from dirt and water during construction.

E. Damage Due to Installation: Protect premises and Work of other Divisions from damage arising out of installation of Work of Divisions 26, 27 and 28. Repair or replace, as directed by the Architect, materials and parts of premises which become damaged as result of installation of Work of Divisions 26, 27 and 28. Remove replaced parts from premises.

1.16 REVIEW OF CONSTRUCTION

A. Review of Work: Work may be reviewed at any time by the Architect. Advise the Architect that Work is ready for review at following times:

1. Prior to backfilling buried Work.
2. Prior to concealment of Work in walls and above ceilings.
3. When all requirements of Contract have been completed.

B. Backfilling and Concealing of Work: Neither backfill nor conceal Work without Architect's consent.

C. Specifications and Drawings: Maintain on site a set of Specifications and Drawings for use by the Architect's representatives.

1.17 SCHEDULE OF WORK

A. Arrange the Work to conform to the schedule of construction established or required to comply with Contract Documents. In scheduling, anticipate means of installing equipment through available openings in structure.

1.18 PERMITS, LICENSES, AND INSPECTIONS

A. Permits and Licenses: Secure required permits and licenses including payments of all charges and fees.

B. Inspections: Refer to Division 01 for requirements.

1.19 WARRANTY

A. Warranty Coverage: Furnish warranty covering all Work in accordance with general requirements of the Contract.

B. Materials, Equipment, Apparatus, and Labor: Provide new materials, equipment, apparatus and labor to replace defective or faulty Work as directed by the Architect.

C. Services: This guarantee also applies to services such as Instructions, Adjusting, Testing, Noise, Balancing, etc.

D. Extended Warranty: Provide the owner with a line item option for a five year parts and labor warranty for the entire electrical system.

E. Refer to Division 01 for additional requirements.

1.20 PRELIMINARY OPERATION

A. Any portion of the system or equipment shall be placed in operation at the request of the Architect prior to the final completion and acceptance of the Work. Such operation shall be under the direct supervision of the Contractor, but the expense thereof will be paid separately and distinct from any money paid on

account of the Contract. Preliminary operation or payment thereof shall not be construed as acceptance of any part of the Work.

1.21 SEAMLESS INTEGRATION

A. "Seamless Integration" between/among various systems is required by these specifications. Affected systems include, but are not limited to the following:

1. Mechanical Controls System or Building Management Systems (BMS)
2. Fire Alarm/Life Safety
3. Security

B. The Contractor shall have overall responsibility for the coordination of all required interfaces, seamless integrations, and compatibility of systems. The Contractor shall ensure that the systems interfaces and integrations are complete, comply with all applicable codes and regulations, and are compatible. The Contractor shall ensure that the integrations include all required software, system modifications and exchange of protocol.

C. The Contractor shall include all costs, to implement the seamless integrations, not covered by the work of the other systems and/or trades. Included in these costs shall be coordination with other trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 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 with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

2.3 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

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 raceways and 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. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07.

C. 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.

D. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

E. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

F. 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.

G. Cut sleeves to length for mounting flush with both surfaces of walls.

H. Extend sleeves installed in floors 2 inches above finished floor level.

I. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require a different clearance.

J. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

K. 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. Refer to Division 07 for materials and installation.

L. 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 Division 07.

M. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

N. Aboveground, Exterior-Wall Penetrations: Seal penetrations using 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.

O. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for 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 underground, 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 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.

3.5 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal installations and associated firestopping for damage and faulty work.

END OF SECTION 26 05 00

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

B. NBR: Acrylonitrile-butadiene rubber.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control test reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

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.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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:

1. Alcan Products Corporation; Alcan Cable Division.
2. American Insulated Wire Corp.; a Leviton Company.
3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

B. Aluminum and Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

2.2 CONNECTORS AND SPLICES

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:

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney; EGS Electrical Group LLC.
4. 3M; Electrical Products Division.
5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 1/0 AWG; copper or aluminum for feeders No. 1/0 AWG and larger. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW, single conductors in raceway.

B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. Class 1 Control Circuits: Type THHN-THWN, in raceway.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches (150 mm) of slack.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.

   a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
   b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
   c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

D. Test Reports: Prepare a written report to record the following:

   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 26 05 19

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Ground rods.
2. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For qualified testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.
    a. Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

b. Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

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

C. 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 (6 mm) 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 (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL 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, 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.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m) 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.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

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 Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

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

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.
2. Lighting circuits.
3. Receptacle circuits.
4. Single-phase motor and appliance branch circuits.
5. Three-phase motor and appliance branch circuits.
6. Flexible raceway runs.

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. Signal and Communication Equipment: In addition to grounding and bonding required by NFPA 70, provide a separate grounding system complying with requirements in TIA/ATIS J-STD-607-A.

1. 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.

2. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-4-by-12-inch (6.3-by-100-by-300-mm) grounding bus.

3. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 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 (50 mm) 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. 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 bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by 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.

E. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

F. Ufer Ground (Concrete-Encased Grounding Electrode): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than No. 2/0 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

3.5 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal. Make tests at ground rods before any conductors are connected.
   a. Measure ground resistance no fewer 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.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 05 26

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Section 260548 "Vibration and Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.
2. Steel slotted channel systems. Include Product Data for components.
3. Equipment supports.

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

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:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Mechanical-Expansion Anchors: Insert-wedge-type, [zinc-coated] [stainless] steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
   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:
      1) Cooper B-Line, Inc.; a division of Cooper Industries.
      2) Empire Tool and Manufacturing Co., Inc.
      3) Hilti Inc.
      4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.

6. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
5. To Light Steel: Sheet metal screws.
6. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: 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 minimum dry film thickness of 2.0 mils (0.05 mm).

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

END OF SECTION 26 05 29

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. LEED Submittals:

1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Qualification Data: For professional engineer.

C. Seismic Qualification Certificates: For enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.

D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. 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:

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.

11. Western Tube and Conduit Corporation.

12. Wheatland Tube Company; a division of John Maneely Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. IMC: Comply with ANSI C80.6 and UL 1242.

E. EMT: Comply with ANSI C80.3 and UL 797.

F. FMC: Comply with UL 1; zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.

2. Fittings for EMT:
   a. Material: Steel.
   b. Type: Setscrew or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

I. Joint Compound for IMC or GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. 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:

1. AFC Cable Systems, Inc.

2. Anamet Electrical, Inc.

3. Arnco Corporation.

4. CANTEX Inc.

5. CertainTeed Corp.

6. Condux International, Inc.

7. Electri-Flex Company.

8. Kraloy.

9. Lamson & Sessions; Carlon Electrical Products.
10. Niedax-Kleinhuis USA, Inc.
11. RACO; a Hubbell company.
12. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Fittings for RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. 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:

1. Cooper B-Line, Inc.
2. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. 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:

1. Adalet.
2. Cooper Technologies Company; Cooper Crouse-Hinds.
3. EGS/Appleton Electric.
4. Erickson Electrical Equipment Company.
5. FSR Inc.
6. Hoffman; a Pentair company.
7. Hubbell Incorporated; Killark Division.
8. Kraloy.
9. Milbank Manufacturing Co.
10. Mono-Systems, Inc.
11. O-Z/Gedney; a brand of EGS Electrical Group.
12. RACO; a Hubbell Company.
13. Robroy Industries.
14. Spring City Electrical Manufacturing Company.
15. Stahlin Non-Metallic Enclosures; a division of Robroy Industries.
16. Thomas & Betts Corporation.
17. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.

4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, round.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

M. Gangable boxes are prohibited.

N. Hinged-Cover Enclosures: Comply with UL 50 and 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. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. 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.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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. Armorcast Products Company.
   b. Carson Industries LLC.
   c. CDR Systems Corporation; Hubbell Power Systems.
   d. NewBasis.
   e. Oldcastle Precast, Inc.; Christy Concrete Products.
   f. Synertech Moulded Products; a division of Oldcastle Precast, Inc.

2. Standard: Comply with SCTE 77.

3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.

4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

6. Cover Legend: Molded lettering, "ELECTRIC.".

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

2.6 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.

2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
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.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
   a. Loading dock.
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
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: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) 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. Comply with NEMA FB 2.10.
2. EMT: Use setscrew or compression, steel fittings. Comply with NEMA FB 2.10.

3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C)].

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) 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. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m)intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Install raceway sealing fittings at accessible locations according to NFPA 70 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 according to NFPA 70.

T. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service raceway enters a building or structure.
3. Where otherwise required by NFPA 70.

U. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

V. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

W. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations.

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

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

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

AA. Locate boxes so that cover or plate will not span different building finishes.

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

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

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

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

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

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

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 26 05 33

SECTION 26 05 48 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

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. Isolation pads.
2. Channel support systems.
3. Restraint cables.
4. Hanger rod stiffeners.
5. Anchorage bushings and washers.

B. Related Sections include the following:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

A. The IBC: International Building Code.

B. ICC-ES: ICC-Evaluation Service.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:

1. Site Class as Defined in the IBC: D.
2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
   a. Component Importance Factor: 1.0.
   b. Component Response Modification Factor: 3.0.
   c. Component Amplification Factor: 2.5.
3. Design Spectral Response Acceleration at Short Periods (0.2 Second): S_{DS}=1.361g.

4. Design Spectral Response Acceleration at 1.0-Second Period: S_{D1}=0.663g.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators and seismic restraints.
   a. Coordinate design calculations with wind-load calculations required for equipment mounted outdoors. Comply with requirements in other electrical Sections for equipment mounted outdoors.
2. Indicate materials and dimensions and identify hardware, including attachment and anchorage devices.
3. Field-fabricated supports.
4. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.6 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

E. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

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:

1. Ace Mountings Co., Inc.
2. Amber/Booth Company, Inc.
3. California Dynamics Corporation.

4. Isolation Technology, Inc.
5. Kinetics Noise Control.
6. Mason Industries.
7. Vibration Eliminator Co., Inc.
8. Vibration Isolation.
9. Vibration Mountings & Controls, Inc.

B. Pads: Arrange in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.

1. Resilient Material: Oil- and water-resistant neoprene.

2.2 SEISMIC-RESTRAINT DEVICES

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:

1. Amber/Booth Company, Inc.
2. California Dynamics Corporation.
3. Cooper B-Line, Inc.; a division of Cooper Industries.
4. Hilti Inc.
5. Loos & Co.; Seismic Earthquake Division.
6. Mason Industries.
7. TOLCO Incorporated; a brand of NIBCO INC.
8. Unistrut; Tyco International, Ltd.

B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

D. Restraint Cables: ASTM A 492 stainless-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for

restraining cable service; and with a minimum of two clamping bolts for cable engagement.

E. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Do not weld stiffeners to rods.

F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.

G. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

2.3 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel or powder coat for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment and Hanger Restraints:

1. Install restrained isolators on electrical equipment.
2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

D. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
5. Set anchors to manufacturer's recommended torque, using a torque wrench.
6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in runs of raceways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where they terminate with connection to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.
6. Measure isolator restraint clearance.
7. Measure isolator deflection.
8. Verify snubber minimum clearances.
9. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Adjust isolators after isolated equipment is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of spring isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 26 05 48

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification of power and control cables.
2. Identification for conductors.
3. Underground-line warning tape.
4. Warning labels and signs.
5. Instruction signs.
6. Equipment identification labels.
7. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 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.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 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.

2.2 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) 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.

2.3 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

2.4 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.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. 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 (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

C. 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 (915 MM)."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) 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.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. 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 (10 mm).

B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.8 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self extinguishing, one piece, self locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).
2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).
3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black except where used for color-coding.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in 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. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of

multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

G. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stencil legend "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- (75-mm-) high black letters on 20-inch (500-mm) centers. Stop stripes at legends. Apply to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.
2. Wall surfaces directly external to raceways concealed within wall.
3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

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. 1 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 (150 mm) 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 [write-on tags] [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.

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. 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: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   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.
2. Equipment to Be Labeled:
   a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchboards.
   e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   f. Emergency system boxes and enclosures.
   g. Enclosed switches.
   h. Enclosed circuit breakers.
   i. Enclosed controllers.
   j. Push-button stations.
   k. Contactors.
   l. Remote-controlled switches, dimmer modules, and control devices.
   m. Battery-inverter units.
   n. Battery racks.
   o. Monitoring and control equipment.
   p. UPS equipment.

END OF SECTION 26 05 53

SECTION 26 09 43 - NETWORK LIGHTING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes manually operated, PC-based, digital lighting controls with external signal source, relays and control module.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for time clocks, photoelectric sensors, occupancy sensors, and multiple contactors.

1.3 DEFINITIONS

A. BACnet: A networking communication protocol that complies with ASHRAE 135.

B. BAS: Building automation system.

C. DALI: Digital addressable lighting interface.

D. LonWorks: A control network technology platform for designing and implementing interoperable control devices and networks.

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling and power-limited circuits.

F. Monitoring: Acquisition, processing, communication, and display of equipment status data, metered electrical parameter values, power quality evaluation data, event and alarm signals, tabulated reports, and event logs.

G. PC: Personal computer; sometimes plural as "PCs."

H. Power Line Carrier: Use of radio-frequency energy to transmit information over transmission lines whose primary purpose is the transmission of power.

I. RS-485: A serial network protocol, similar to RS-232, complying with TIA-485-A.

J. UTP: Unshielded twisted pair.

1.4 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 control modules, power distribution components, manual switches and plates, and conductors and cables.

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

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Outline Drawings: Indicate dimensions, weights, arrangement of components, and clearance and access requirements.

3. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices to be used. Describe characteristics of network and other data communication lines.

4. Wiring Diagrams: For power, signal, and control wiring. Coordinate nomenclature and presentation with a block diagram.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in other Sections.

1. Show interconnecting signal and control wiring and interfacing devices that prove compatibility of inputs and outputs.

2. For networked controls, list network protocols and provide statements from manufacturers that input and output devices meet interoperability requirements of the network protocol.

B. Field quality-control reports.

C. Software licenses and upgrades required by and installed for operation and programming of digital and analog devices.

D. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting controls to include in emergency, operation, and maintenance manuals.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On a magnetic media or compact disc, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

A. Source Limitations: Obtain lighting control module and power distribution components through one source from a single manufacturer.

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

C. Comply with 47 CFR, Subparts A and B, for Class A digital devices.

D. Comply with protocol described in IEC 60929, Annex E, for DALI lighting control devices, wiring, and computer hardware and software.

E. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate lighting control components to form an integrated interconnection of compatible components.

1. Match components and interconnections for optimum performance of lighting control functions.
2. Coordinate lighting controls with that in Sections specifying distribution components that are monitored or controlled by power monitoring and control equipment.

B. Coordinate lighting control components specified in this Section with components specified in Section 262416 "Panelboards."

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of lighting controls that fail in materials or workmanship or from transient voltage surges within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Failure of software input/output to execute switching or dimming commands.
   b. Failure of modular relays to operate under manual or software commands.
   c. Damage of electronic components due to transient voltage surges.

2. Warranty Period: Two years from date of Substantial Completion.

3. Extended Warranty Period Failure Due to Transient Voltage Surges: Eight years.

4. Extended Warranty Period for Electrically Held Relays: 10 years from date of Substantial Completion.

1.10 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning with Substantial Completion, provide software support for two years.

B. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of the software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Acuity Brands Lighting, Inc.; Lithonia Lighting brand.
2. Intelligent Lighting Controls.
3. Leviton Mfg. Company Inc.
4. Lighting Control & Design, Inc.
5. Lightolier Controls; a division of Genlyte Group, LLC.
6. Lutron Electronics Co., Inc.
7. NexLight; part of the Northport Engineering Group.
8. Square D; a brand of Schneider Electric.
9. Starfield Controls, Inc.
10. Touch-Plate Technologies.
11. Triatek, Inc.
12. Watt Stopper/Legrand.

2.2 SYSTEM REQUIREMENTS

A. Expandability: System shall be capable of increasing the number of control functions in the future by 25 percent of current capacity; to include equipment ratings, housing capacities, spare relays, terminals, number of conductors in control cables, and control software.

B. Performance Requirements: Manual switches, an internal timing and control unit, and external sensors or other control signal sources send a signal to a PC-based network-system control module that processes the signal according to its programming and routes an open or close command to one or more relays in the power-supply circuits, or routes variable commands to one or more dimmers, for groups of lighting fixtures or other loads.

2.3 CONTROL MODULE

A. Control Module Description: Comply with UL 916 (CSA C22.2, No. 205); microprocessor-based, solid-state, 365-day timing and control unit. Output circuits shall be switched on or off by internally programmed time signals or by program-controlled analog or digital signals from external sources. Output circuits shall be pilot-duty relays compatible with power switching devices. An integral keypad shall provide local programming and control capability. A key-locked cover and a programmed security access code shall protect keypad use. An integral alphanumeric LCD or LED shall display menu-assisted programming and control.

2.4 POWER DISTRIBUTION COMPONENTS

A. Modular Relay Panel: Comply with UL 508 (CAN/CSA C22.2, No. 14) and UL 916 (CSA C22.2, No. 205); factory assembled with modular single-pole relays, power supplies, and accessory components required for specified performance.

1. Cabinet: Steel with hinged, locking door.
   a. Barriers separate low-voltage and line-voltage components.
   b. Directory: Mounted on back of door. Identifies each relay as to load groups controlled and each programmed pilot device if any.
   c. Control Power Supply: Transformer and full-wave rectifier with filtered dc output.
2. Single-Pole Relays: Mechanically held unless otherwise indicated; split-coil, momentary-pulsed type.
   a. Low-Voltage Leads: Plug connector to the connector strip in cabinet and pilot light power where indicated.
   b. Rated Capacity (Mounted in Relay Panel): 20 A, 125-V ac for tungsten filaments; 20 A, 277-V ac for ballasts.
   c. Endurance: 50,000 cycles at rated capacity.
   d. Mounting: Provision for easy removal and installation in relay cabinet.

B. Line-Voltage Surge Suppression: Factory installed as an integral part of 120- and 277-V ac, solid-state control panels.

2.5 MANUAL ANALOG SWITCHES AND PLATES

A. Manual, Maintained Contact, Full- or Low-Voltage Switch: Comply with Section 262726 "Wiring Devices."

B. Wall Plates: Single and multigang plates as specified in Section 262726 "Wiring Devices."

C. Legend: Engraved or permanently silk-screened on wall plate where indicated. Use designations indicated on Drawings.

2.6 FIELD-MOUNTED DIGITAL CONTROLS AND PLATES

A. Connection Type: RS-485 protocol, category 5e UTP cable, using RJ45 connectors. Power shall be from the control unit.

B. Pushbutton Switches: Modular, solid-state, programmable, digital, momentary contact, designed to connect to a microprocessor based control unit as a manual control source.

1. Mounting: Standard single-gang recessed switchbox, using device plates specified in Section 262726 "Wiring Devices."
2. Multi-Gang Mounting: One to six pushbuttons per gang.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Class 2 Power Source: Not smaller than No. 12 AWG, complying with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. RS-485 Cables:

1. Standard Cable: NFPA 70, Type CM or CMG.
   a. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
   b. PVC insulation.
   c. Unshielded.
   d. PVC jacket.
   e. Flame Resistance: Comply with UL 1581.
2. Plenum-Rated Cable: NFPA 70, Type CMP.
   a. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
   b. Fluorinated ethylene propylene insulation.
   c. Unshielded.
   d. Fluorinated ethylene propylene jacket.
   e. Flame Resistance: NFPA 262, Flame Test.

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Install wiring in raceways. Minimum conduit size shall be 3/4 inch (19 mm).

1. For power wiring comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

2. For digital data transmission and low-voltage (operating at less than 50 V) remote control and signaling cables, comply with Section 260523 "Control-Voltage Electrical Power Cables."

C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and non-power-limited conductors according to conductor manufacturer's written instructions.

D. Install field-mounting transient voltage suppressors for lighting control devices in Category A locations that do not have integral line-voltage surge protection.

E. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

F. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in terminal cabinets, equipment enclosures, and in junction, pull, and outlet boxes.

G. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Test for circuit continuity.

2. Verify that the control module features are operational.

3. Check operation of local override controls.

4. Test system diagnostics by simulating improper operation of several components selected by Architect.

E. Lighting controls will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 SOFTWARE INSTALLATION

A. Install and program software with initial settings of adjustable values. Make backup copies of software and user-supplied values. Provide current licenses for software.

3.4 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting controls. See Section 017900 "Demonstration and Training."

END OF SECTION 26 09 43

SECTION 26 22 00 - LOW-VOLTAGE TRANSFORMERS

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 types of dry-type transformers rated 600 V and less, with capacities up to 1000 kVA:

1.3 ACTION SUBMITTALS

A. Product Data: Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Seismic Qualification Certification: Submit certification that transformers, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Qualification Data: For testing agency.

C. Source quality-control test reports.

D. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.

C. Source Limitations: Obtain each transformer type through one source from a single manufacturer.

D. 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.

E. Comply with IEEE C57.12.91, "Test Code for Dry-Type Distribution and Power Transformers."

1.7 COORDINATION

A. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

B. Coordinate installation of wall-mounting and structure-hanging supports with actual transformer provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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:

1. ACME Electric Corporation; Power Distribution Products Division.
2. Challenger Electrical Equipment Corp.; a division of Eaton Corp.
3. Controlled Power Company.
4. Eaton Electrical Inc.; Cutler-Hammer Products.
5. Federal Pacific Transformer Company; Division of Electro-Mechanical Corp.
6. General Electric Company.
7. Hammond Co.; Matra Electric, Inc.
8. Magnetek Power Electronics Group.
9. Micron Industries Corp.
10. Myers Power Products, Inc.
11. Siemens Energy & Automation, Inc.
12. Sola/Hevi-Duty.
13. Square D; Schneider Electric.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Cores: Grain-oriented, non-aging silicon steel.

C. Coils: Continuous windings without splices except for taps.

1. Internal Coil Connections: Brazed or pressure type.
2. Coil Material: Copper.

2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NEMA ST 20, and list and label as complying with UL 1561.

B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Cores: One leg per phase.

D. Enclosure: Ventilated, NEMA 250, Type 2.

1. Core and coil shall be encapsulated within resin compound, sealing out moisture and air.

E. Transformer Enclosure Finish: Comply with NEMA 250.

1. Finish Color: [Gray] [ANSI 49 gray] [ANSI 61 gray].

F. Taps for Transformers Smaller Than 3 kVA: None.

G. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.

H. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

I. Insulation Class: 220 deg C, UL-component-recognized insulation system with a maximum of 150 deg C rise above 40 deg C ambient temperature.

J. Energy Efficiency for Transformers Rated 15 kVA and Larger:

1. Complying with NEMA TP 1, Class 1 efficiency levels.

2. Tested according to NEMA TP 2.

K. Wall Brackets: Manufacturer's standard brackets.

L. Fungus Proofing: Permanent fungicidal treatment for coil and core.

M. Low-Sound-Level Requirements: Minimum of 3 dBA less than NEMA ST 20 standard sound levels when factory tested according to IEEE C57.12.91.

2.4 IDENTIFICATION DEVICES

A. Nameplates: Engraved, laminated-plastic or metal nameplate for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.91.

B. Factory Sound-Level Tests: Conduct sound-level tests on equipment for this Project.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounting transformers level and plumb with wall brackets fabricated by transformer manufacturer.

1. Brace wall-mounting transformers as specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Construct concrete bases and anchor floor-mounting transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."

3.3 CONNECTIONS

A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

E. Remove and replace units that do not pass tests or inspections and retest as specified above.

F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.

1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.

2. Perform 2 follow-up infrared scans of transformers, one at 4 months and the other at 11 months after Substantial Completion.

3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 10 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 26 22 00

SECTION 26 24 13 - SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Transient voltage suppression devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.

1.3 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.

2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Samples: Representative portion of mimic bus with specified material and finish, for color selection.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: Submit certification that switchboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

C. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

F. Comply with NEMA PB 2.

G. Comply with NFPA 70.

H. Comply with UL 891.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Remove loose packing and flammable materials from inside switchboards and install temporary electric heating (250 W per section) to prevent condensation.

C. Handle and prepare switchboards for installation according to NECA 400.

1.10 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
   a. Ambient Temperature: Not exceeding 104 deg F (40 deg C).
   b. Altitude: Not exceeding 6600 feet (2000 m).

C. Service Conditions: NEMA PB 2, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet (2000 m).

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.12 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

C. Nominal System Voltage: 480Y/277 V.

D. Main-Bus Continuous: 600 A.

E. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

F. Indoor Enclosures: Steel, NEMA 250, Type 1.

G. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

H. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.

2. Enclosure: Downward, rearward sloping roof; bolt-on rear covers for each section, with provisions for padlocking.

I. Barriers: Between adjacent switchboard sections.

J. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.

K. Utility Metering Compartment: Fabricated, barrier compartment and section complying with utility company's requirements; hinged sealed door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.

L. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.

M. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

N. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

O. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, with tin-plated aluminum or copper feeder circuit-breaker line connections.

2. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.

3. Ground Bus: 1/4-by-2-inch- (6-by-50-mm-) hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.

4. Main Phase Buses and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.

5. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

6. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

P. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

Q. Bus-Bar Insulation: Factory-applied, flame-retardant, tape wrapping of individual bus bars or flame-retardant, spray-applied insulation. Minimum insulation temperature rating of 105 deg C.

R. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

2.2 TRANSIENT VOLTAGE SUPPRESSION DEVICES

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Surge Protection Device Description: IEEE C62.41-compliant, integrally mounted, wired-in, solid-state, parallel-connected, modular (with field-replaceable modules) type, with sine-wave tracking suppression and filtering modules, UL 1449, second edition, short-circuit current rating matching or exceeding the switchboard short-circuit rating, and with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.

2. Fabrication using bolted compression lugs for internal wiring.

3. Integral disconnect switch.

4. Redundant suppression circuits.

5. Redundant replaceable modules.

6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

7. LED indicator lights for power and protection status.

8. Audible alarm, with silencing switch, to indicate when protection has failed.

9. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of system operation. Contacts shall reverse position on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.

10. Four-digit, transient-event counter set to totalize transient surges.

C. Peak Single-Impulse Surge Current Rating: 160 kA per mode/320 kA per phase.

D. Withstand Capabilities: 12,000 IEEE C62.41, Category C3 (10 kA), 8-by-20-mic.sec. surges with less than 5 percent change in clamping voltage.

E. Protection modes and UL 1449 SVR for grounded wye circuits with 480Y/277-V, three-phase, four-wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277.

2. Line to Ground: 800 V for 480Y/277.

3. Neutral to Ground: 800 V for 480Y/277.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
   f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

2.4 INSTRUMENTATION

A. Instrument Transformers: IEEE C57.13, NEMA EI 21.1, and the following:

1. Potential Transformers: IEEE C57.13; 120 V, 60 Hz, single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
2. Current Transformers: IEEE C57.13; 5 A, 60 Hz, secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.
4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
   a. Phase Currents, Each Phase: Plus or minus 1 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
   d. Megawatts: Plus or minus 2 percent.
   e. Megavars: Plus or minus 2 percent.
   f. Power Factor: Plus or minus 2 percent.
   g. Frequency: Plus or minus 0.5 percent.
   h. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent; accumulated values unaffected by power outages up to 72 hours.
   i. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from five to 60 minutes.
   j. Contact devices to operate remote impulse-totalizing demand meter.
2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.6 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NECA 400.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NECA 400.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. 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 concrete base.
2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to switchboards.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Switchboard will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.7 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 26 24 13

SECTION 26 24 16 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. TVSS: Transient voltage surge suppressor.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, transient voltage suppression device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types and details for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.

4. Short-circuit current rating of panelboards and overcurrent protective devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
6. Include wiring diagrams for power, signal, and control wiring.
7. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: Submit certification that panelboards, overcurrent protective devices, accessories, and components will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.8 MAINTENANCE MATERIAL SUBMITTALS

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

1. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NECA 407.

1.11 PROJECT CONDITIONS

A. Environmental Limitations:

1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
b. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.

2. Altitude not exceeding 6600 feet (2000 m).

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of electric service.

2. Do not proceed with interruption of electric service without Owner's written permission.

3. Comply with NFPA 70E.

1.12 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.13 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

B. Enclosures: Surface-mounted cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Outdoor Locations: NEMA 250, Type 3R.
   c. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
   d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 5.
2. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.
3. Finishes:
   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
   b. Back Boxes: Galvanized steel.
4. Directory Card: Inside panelboard door, mounted in transparent card holder.

C. Incoming Mains Location: Top and bottom.

D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
2. Main and Neutral Lugs: Mechanical type.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, power and feeder distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

D. Mains: Circuit breaker or Lugs only.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).
3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
5. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
   d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
   e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
   f. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
   g. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
   h. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store panelboards according to NECA 407.

B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.

C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install panelboards and accessories according to NECA 407.

B. Equipment Mounting: Install panelboards on concrete bases, 4-inch (100-mm) nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around full perimeter of base.
2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to panelboards.
5. Attach panelboard to the vertical finished or structural surface behind the panelboard.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

D. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

G. Install overcurrent protective devices and controllers not already factory installed.

H. Install filler plates in unused spaces.

I. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

J. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
   c. Instruments and Equipment:
      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

F. Panelboards will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

3.6 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 24 16

SECTION 26 27 26 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Wall-switch and exterior occupancy sensors.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

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; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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. Cooper; 5351 (single), CR5362 (duplex).
   b. Hubbell; HBL5351 (single), HBL5352 (duplex).
   c. Leviton; 5891 (single), 5352 (duplex).
   d. Pass & Seymour; 5361 (single), 5362 (duplex).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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. Cooper; VGF20.
   b. Hubbell; GFR5352L.
   c. Pass & Seymour; 2095.
   d. Leviton; 7590.

2.5 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

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. Single Pole:

b. Cooper; AH1221.
c. Hubbell; HBL1221.
d. Leviton; 1221-2.
e. Pass & Seymour; CSB20AC1.

2.7 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.04-inch- (1-mm-) 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 and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.8 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by NFPA 70 or device listing.
2. Wiring Devices Connected to Emergency Power System: Red.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. 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 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 right 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. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that 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, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by 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. 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 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. 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 unacceptable.
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. 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 ones, and retest as specified above.
7. Wiring device will be considered defective if it does not pass tests and inspections.

B. Prepare test and inspection reports.

END OF SECTION 26 27 26

SECTION 26 28 13 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches and enclosed controllers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
   a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
   b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.
4. Coordination charts and tables and related data.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

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

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

1.6 PROJECT CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.7 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. Cooper Bussmann, Inc.
2. Edison Fuse, Inc.

3. Ferraz Shawmut, Inc.
4. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

A. Cartridge Fuses:
1. Motor Branch Circuits: Class RK1, time delay.
2. Other Branch Circuits: Class RK1, time delay.
3. Control Circuits: Class CC, fast acting.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 26 28 13

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Shunt trip switches.
4. Molded-case circuit breakers (MCCBs).
5. Molded-case switches.
6. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and

manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.
5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

1.8 MAINTENANCE MATERIAL SUBMITTALS

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

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

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

E. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
2. Altitude: Not exceeding 6600 feet (2010 m).

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.11 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.

7. Service-Rated Switches: Labeled for use as service equipment.
8. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Hookstick Handle: Allows use of a hookstick to operate the handle.
5. Lugs: Mechanical type, suitable for number, size, and conductor material.
6. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 SHUNT TRIP SWITCHES

A. 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:

1. Cooper Bussmann, Inc.
2. Ferraz Shawmut, Inc.
3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight green ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

D. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

E. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

F. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
8. Alarm Switch: One NC contact that operates only when circuit breaker has tripped.
9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
10. Electrical Operator: Provide remote control for on, off, and reset operations.
11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.5 MOLDED-CASE SWITCHES

A. 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:

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Energy & Automation, Inc.
4. Square D; a brand of Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
7. Alarm Switch: One NC contact that operates only when switch has tripped.
8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
9. Electrical Operator: Provide remote control for on, off, and reset operations.
10. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.
6. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

E. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:
   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 26 28 16

SECTION 26 33 23 - CENTRAL BATTERY EQUIPMENT

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 fast-transfer central battery inverters with the following features:

1. Output distribution section.
2. Internal maintenance bypass/isolation switch.

1.3 DEFINITIONS

A. LCD: Liquid-crystal display.

B. LED: Light-emitting diode.

C. THD: Total harmonic distortion.

D. UPS: Uninterruptible power supply.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Electrical ratings, including the following:
   a. Capacity to provide power during failure of normal ac.
   b. Inverter voltage regulation and THD of output current.
   c. Rectifier data.
   d. Transfer time of transfer switch.
   e. Data for specified optional features.
2. Transfer switch.
3. Inverter.
4. Battery charger.
5. Batteries.
6. Battery monitoring.

7. Battery-cycle warranty monitor.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, components, and location and identification of each field connection. Show access, workspace, and clearance requirements; details of control panels; and battery arrangement.

1. Wiring Diagrams: Detail internal and interconnecting wiring; and power, signal, and control wiring.

2. Elevation and details of control and indication displays.

3. Output distribution section.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Manufacturer Seismic Qualification Certification: Submit certification that central battery inverter equipment will withstand seismic forces defined in Section 260548 "Vibration and Seismic Controls for Electrical Systems." Include the following:

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For central battery inverter equipment to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.

1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
2. Cabinet Ventilation Filters: One complete set.
3. One spare circuit board for each critical circuit.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of the InterNational Electrical Testing Association or is an NRTL acceptable to authorities having jurisdiction.

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.

C. Central Battery Inverter System: UL 924 and UL 1778 listed.

D. Comply with NFPA 70 and NFPA 101.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment in fully enclosed vehicles.

B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace batteries that fail in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.

1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
   a. Premium, Valve-Regulated, Recombinant, Lead-Calcium Batteries:
      1) Full Warranty: One year.
      2) Pro Rata: 19 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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:

1. Bigbeam Emergency Systems, Inc.; Siltron Division.
2. Chloride Systems.
3. Cooper Industries, Inc.; Sure-Lites Division.
4. Crucial Power Products.
5. Dual-Lite.
6. Hubbell Incorporated; Hubbell Lighting.
7. Lightguard/Chloride Systems.
8. Lithonia Lighting; Emergency Lighting Systems.
9. Thomas & Betts Corporation; Emergi-Lite Division.
10. Thomas & Betts Corporation; Lightalarms Division.

2.2 INVERTER PERFORMANCE REQUIREMENTS

A. Fast-Transfer Central Battery Inverters: Automatically sense loss of normal ac supply and use a solid-state switch to transfer loads. Transfer in 0.004 second or less from normal supply to battery-inverter supply.

1. Operation: Unit supplies power to output circuits from a single, external, normal supply source. Unit automatically transfers load from normal source to internal battery/inverter source. Retransfer to normal is automatic when normal power is restored.

B. Maximum Acoustical Noise: 45 dB, "A" weighting, emanating from any UPS component under any condition of normal operation, measured 39 inches (990 mm) from nearest surface of component enclosure.

2.3 SERVICE CONDITIONS

A. Environmental Conditions: Inverter system shall be capable of operating continuously in the following environmental conditions without mechanical or electrical damage or degradation of operating capability:

1. Ambient Temperature for Electronic Components: 32 to 98 deg F (0 to 37 deg C).
2. Relative Humidity: 0 to 95 percent, noncondensing.
3. Altitude: Sea level to 4000 feet (1220 m).

2.4 INVERTERS

A. Description: Solid-state type, with the following operational features:

1. Automatically regulate output voltage to within plus or minus 5 percent.
2. Automatically regulate output frequency to within plus or minus 1 Hz, from no load to full load at unit power factor over the operating range of battery voltage.

3. Output Voltage Waveform of Unit: Sine wave with maximum 10 percent THD throughout battery operating-voltage range, from no load to full load.
   a. THD may not exceed 5 percent when serving a resistive load of 100 percent of unit rating.
4. Output Protection: Current-limiting and short-circuit protection.
5. Overload Capability: 125 percent for 10 minutes; 150 percent surge.
6. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.

2.5 BATTERY CHARGER

A. Description: Solid-state, automatically maintaining batteries in fully charged condition when normal power is available. With LED indicators for "float" and "high-charge" modes.

2.6 BATTERIES

A. Description: Premium, valve-regulated, recombinant, lead-calcium batteries.
   1. Capable of sustaining full-capacity output of inverter unit for minimum of 90 minutes.

2.7 ENCLOSURES

A. NEMA 250, Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.

B. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment.

2.8 SEISMIC REQUIREMENTS

A. Central battery inverter assemblies, subassemblies, components, fastenings, supports, and mounting and anchorage devices shall be designed and fabricated to withstand seismic forces. The term "withstand" is defined in the "Manufacturer Seismic Qualification Certification" Paragraph in Part 1 "Informational Submittals" Article.

2.9 CONTROL AND INDICATION

A. Description: Group displays, indications, and basic system controls on common control panel on front of central battery inverter enclosure.

B. Minimum displays, indicating devices, and controls shall include those in lists below. Provide sensors, transducers, terminals, relays, and wiring required to support listed items. Alarms shall include an audible signal and a visual display.

C. Indications: Labeled LED.

1. Quantitative Indications:
   a. Input voltage, each phase, line to line.
   b. Input current, each phase, line to line.
   c. System output voltage, each phase, line to line.
   d. System output current, each phase.
   e. System output frequency.
   f. DC bus voltage.
   g. Battery current and direction (charge/discharge).
   h. Elapsed time-discharging battery.
2. Basic Status Condition Indications:
   a. Normal operation.
   b. Load-on bypass.
   c. Load-on battery.
   d. Inverter off.
   e. Alarm condition exists.
3. Alarm Indications:
   a. Battery system alarm.
   b. Control power failure.
   c. Fan failure.
   d. Overload.
   e. Battery-charging control faulty.
   f. Input overvoltage or undervoltage.
   g. Approaching end of battery operation.
   h. Battery undervoltage shutdown.
   i. Inverter fuse blown.
   j. Inverter transformer overtemperature.
   k. Inverter overtemperature.
   l. Static bypass transfer switch overtemperature.
   m. Inverter power supply fault.
   n. Inverter output overvoltage or undervoltage.
   o. System overload shutdown.
   p. Inverter output contactor open.
   q. Inverter current limit.
4. Controls:
   a. Inverter on-off.
   b. Start.
   c. Battery test.
   d. Alarm silence/reset.
   e. Output-voltage adjustment.

D. Dry-form "C" contacts shall be available for remote indication of the following conditions:

1. Inverter on battery.
2. Inverter on-line.
3. Inverter load-on bypass.
4. Inverter in alarm condition.
5. Inverter off (maintenance bypass closed).

E. Include the following minimum array:

1. Ready, normal-power on light.
2. Charge light.
3. Inverter supply load light.
4. Battery voltmeter.
5. AC output voltmeter with minimum accuracy of 2 percent of full scale.
6. Load ammeter.
7. Test switch to simulate ac failure.

F. Enclosure: Steel, with hinged lockable doors, suitable for [wall] [floor] mounting. Manufacturer's standard corrosion-resistant finish.

2.10 OPTIONAL FEATURES

A. Maintenance Bypass/Isolation Switch: Load is supplied, bypassing central battery inverter system. Normal supply, electromechanical transfer switch, and system load terminals are completely disconnected from external circuits.

2.11 OUTPUT DISTRIBUTION SECTION

A. Panelboard: Comply with Section 262416 "Panelboards" except provide assembly integral to equipment cabinet.

2.12 SYSTEM MONITORING AND ALARMS

A. Remote Status and Alarm Panel: Labeled LEDs on panel faceplate shall indicate five basic status conditions. Audible signal indicates alarm conditions. Silencing switch in face of panel silences signal without altering visual indication.

1. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

B. Battery Ground-Fault Detector: Initiates alarm when resistance to ground of positive or negative bus of battery is less than 5000 ohms.

1. Annunciation of Alarms: At inverter system control panel.

C. Battery-Cycle Warranty Monitoring: Electronic device, acceptable to battery manufacturer as a basis for warranty action, for monitoring charge-discharge cycle history of batteries covered by cycle-life warranty.

1. Basic Functional Performance: Automatically measures and records each discharge event, classifies it according to duration category, and totals discharges according to warranty criteria, displaying remaining warranted battery life on integral LCD.
2. Additional monitoring functions and features shall include the following:

a. Measuring and recording of total voltage at battery terminals; providing alarm for excursions outside proper float voltage level.
b. Monitoring of ambient temperature at battery and initiating an alarm if temperature deviates from normally acceptable range.
c. Keypad on device front panel provides access to monitored data using front panel display.
d. Alarm contacts arranged to provide local alarm for abnormal battery voltage or temperature.
e. Memory device to store recorded data in nonvolatile electronic memory.
f. RS-232 port to permit downloading of data to a portable personal computer.
g. Modem to make measurements and recorded data accessible to remote personal computer via telephone line. Computer will be provided by Owner.

2.13 SOURCE QUALITY CONTROL

A. Factory test complete inverter system, including battery, before shipment. Include the following:

1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
2. Full-load test.
3. Transient-load response test.
4. Overload test.
5. Power failure test.

B. Observation of Test: Give 14 days' advance notice of tests and provide access for Owner's representative to observe tests at Owner's option.

C. Report test results. Include the following data:

1. Description of input source and output loads used. Describe actions required to simulate source load variation and various operating conditions and malfunctions.
2. List of indications, parameter values, and system responses considered satisfactory for each test action. Include tabulation of actual observations during test.
3. List of instruments and equipment used in factory tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install system components on concrete base and attach by bolting.

1. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Section 260548 "Vibration and Seismic Controls for Electrical Systems" for seismic-restraint requirements.

2. Concrete Bases: 4 inches (100 mm) high, reinforced, with chamfered edges. Extend base no more than 3 inches (75 mm) in all directions beyond the maximum dimensions of switchgear unless otherwise indicated or unless required for seismic anchor support. Construct concrete bases according to Section 260529 "Hangers and Supports for Electrical Systems."

3. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

4. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

5. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete and reinforcement as specified in Section 033000 "Cast-in-Place Concrete".

B. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.

3.3 CONNECTIONS

A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams, unless otherwise indicated.

B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with NFPA 70.

C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify equipment and components according to Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

C. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Inspect interiors of enclosures for integrity of mechanical and electrical connections, component type and labeling verification, and ratings of installed components.
2. Test manual and automatic operational features and system protective and alarm functions.
3. Test communication of status and alarms to remote monitoring equipment.
4. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specifications. Certify compliance with test parameters.
5. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Remove and replace malfunctioning units and retest as specified above.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Verify that central battery inverter is installed and connected according to the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.

D. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING AND CLEANING

A. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

B. Install new filters in each equipment cabinet within 14 days from date of Substantial Completion.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery inverters. Refer to Section 017900 "Demonstration and Training."

END OF SECTION 26 33 23

SECTION 26 51 00 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, lamps, and ballasts.
2. Exit signs.
3. Lighting fixture supports.

B. Related Sections:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multiple lighting relays and contactors.
2. Section 260943 "Network Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Ballast, including BF.
4. Energy-efficiency data.
5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Action Submittals" Article in Section 233713 "Diffusers, Registers, and Grilles."
6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Section 233713 "Diffusers, Registers, and Grilles."
7. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
8. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
   b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom lighting fixtures. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Installation instructions.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting fixtures.
2. Structural members to which suspension systems for lighting fixtures will be attached.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, from manufacturer.

D. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910, complying with the IESNA Lighting Measurements Testing & Calculation Guides.

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

C. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

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 LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

C. HID Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5B.

D. Metal Parts: Free of burrs and sharp corners and edges.

E. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

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.

G. 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 (3.175 mm) minimum unless otherwise indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass unless otherwise indicated.

H. 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. "USE ONLY" and include specific lamp type.
   b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and 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, etc.) for fluorescent and compact fluorescent luminaires.
   e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
   f. CCT and CRI for all luminaires.

I. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Comply with UL 935 and with ANSI C82.11.
2. Designed for type and quantity of lamps served.
3. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 10 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Operating Frequency: 42 kHz or higher.
8. Lamp Current Crest Factor: 1.7 or less.
9. BF: 0.88 or higher.
10. Power Factor: 0.95 or higher.
11. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

E. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature with indicated lamp types.

F. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.

1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
   a. High-Level Operation: 100 percent of rated lamp lumens.
   b. Low-Level Operation: 30 percent of rated lamp lumens.
2. Ballast shall provide equal current to each lamp in each operating mode.

3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 BALLASTS FOR HID LAMPS

A. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:

1. Minimum Starting Temperature: Minus 20 deg F (Minus 29 deg C) for single-lamp ballasts.
2. Rated Ambient Operating Temperature: 130 deg F (54 deg C).
3. Lamp end-of-life detection and shutdown circuit.
4. Sound Rating: Class A.
5. Total Harmonic Distortion Rating: Less than 20 percent.
6. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
7. Lamp Current Crest Factor: 1.5 or less.
8. Power Factor: 0.90 or higher.
9. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

10. Protection: Class P thermal cutout.

B. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter/starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.

2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

2.6 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.
   f. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.7 FLUORESCENT LAMPS

A. T8 rapid-start lamps, rated 32 W maximum, nominal length of 48 inches (1220 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life 20,000 hours unless otherwise indicated.

B. T5 rapid-start lamps, rated 28 W maximum, nominal length of 45.2 inches (1150 mm), 2900 initial lumens (minimum), CRI 85 (minimum), color temperature 3500 K, and average rated life of 20,000 hours unless otherwise indicated.

C. T5HO rapid-start, high-output lamps, rated 54 W maximum, nominal length of 45.2 inches (1150 mm), 5000 initial lumens (minimum), CRI 85 (minimum), color temperature [4100] <Insert value> K, and average rated life of 20,000 hours unless otherwise indicated.

D. Compact Fluorescent Lamps: 4-Pin, CRI 80 (minimum), color temperature 3500 K, average rated life of 10,000 hours at three hours operation per start unless otherwise indicated.

1. 32 W: T4, triple tube, rated 2400 initial lumens (minimum).

2. 42 W: T4, triple tube, rated 3200 initial lumens (minimum).

2.8 HID LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamps: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and color temperature 4000 K.

C. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and color temperature 4000 K.

2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.

C. Twin-Stem Hangers: Two, 1/2-inch (13-mm) 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 (2.68 mm).

E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage (2.68 mm).

F. Rod Hangers: 3/16-inch (5-mm) 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:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and fixture shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), 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.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

E. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 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. Verify that self-luminous exit signs are installed according to their listing and the requirements in NFPA 101.

C. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

END OF SECTION 26 51 00

SECTION 26 56 00 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Exterior luminaires with lamps and ballasts.
2. Poles and accessories.

B. Related Sections:

1. Section 265100 "Interior Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. HID: High-intensity discharge.

D. LER: Luminaire efficacy rating.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

F. Pole: Luminaire support structure, including tower used for large area illumination.

G. Standard: Same definition as "Pole" above.

1.4 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 (2224 N), distributed as stated in AASHTO LTS-4-M.

C. 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 50 feet (15 m) high or less is 100 mph (45 m/s).
   a. Wind Importance Factor: 1.0.
   b. Minimum Design Life: 25 years.
   c. Velocity Conversion Factors: 1.0.

1.5 ACTION SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
2. Details of attaching luminaires and accessories.
3. Details of installation and construction.
4. Luminaire materials.
5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
   a. Testing Agency Certified Data: For indicated luminaires, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
   b. Manufacturer Certified Data: Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, CCT, CRI, lumens, and energy-efficiency data.
9. Materials, dimensions, and finishes of poles.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

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

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Anchor-bolt templates keyed to specific poles and certified by manufacturer.

3. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

4. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4-M and that load imposed by luminaire and attachments has been included in design. The certification shall be based on design calculations by a professional engineer.

B. Qualification Data: For qualified agencies providing photometric data for lighting fixtures.

C. Field quality-control reports.

D. Warranty: Sample of special warranty.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.

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

C. Comply with IEEE C2, "National Electrical Safety Code."

D. Comply with NFPA 70.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches (300 mm) above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.
3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

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 Fluorescent Fixtures: Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
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.

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.

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 diameter code (T-4, T-5, T-8, T-12), tube configuration (twin, quad, triple), base type, and nominal wattage for fluorescent and 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) for fluorescent and compact fluorescent luminaires.
   e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
   f. CCT and CRI for all luminaires.

2.3 FLUORESCENT BALLASTS AND LAMPS

A. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F (Minus 17 Deg C) and Higher: Electronic type rated for 0 deg F (minus 17 deg C) starting and operating temperature 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. Case Temperature for Compact Lamp Ballasts: 65 deg C, maximum.

5. 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 (minus 18 deg C) and higher.

2.4 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 (Minus 30 deg C).

3. Normal Ambient Operating Temperature: 104 deg F (40 deg C).

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.

1. Instant-Restrike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
   a. Restrike Range: 105- to 130-V ac.
   b. Maximum Voltage: 250-V peak or 150-V ac rms.

2. Minimum Starting Temperature: Minus 40 deg F (Minus 40 deg C).

2.5 HID LAMPS

A. High-Pressure Sodium Lamps: ANSI C78.42, CRI 21 (minimum), CCT color temperature 1900 K, and average rated life of 24,000 hours, minimum.

1. Dual-Arc Tube Lamp: Arranged so only one of two arc tubes is lighted at one time and, when power is restored after an outage, the cooler arc tube, with lower internal pressure, lights instantly, providing an immediate 8 to 15 percent of normal light output.

B. Metal-Halide Lamps: ANSI C78.43, with minimum CRI 65, and CCT color temperature 4000 K.

C. Pulse-Start, Metal-Halide Lamps: Minimum CRI 65, and CCT color temperature 4000 K.

D. Ceramic, Pulse-Start, Metal-Halide Lamps: Minimum CRI 80, and CCT color temperature 4000 K.

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 (65 by 130 mm), with cover secured by stainless-steel captive screws.

E. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."

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: Round, tapered.

2. Mounting Provisions: Butt flange for bolted mounting on foundation.

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-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. Grounding and Bonding Lugs: Welded 1/2-inch (13-mm) threaded lug, complying with requirements in Section 260526 "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.

F. 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.

G. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

H. Galvanized Finish: After fabrication, hot-dip galvanize complying with ASTM A 123/A 123M.

I. 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 indicated by manufacturer's designations.

2.8 POLE ACCESSORIES

A. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

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.

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 (1520 mm).

2. Water, Gas, Electric, Communication, and Sewer Lines: 10 feet (3 m).

3. Trees: 15 feet (5 m) 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 Section 033000 "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- (13-mm-) diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch- (150-mm-) 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 (25 mm) below top of concrete slab.

F. 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 (100 mm) 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 Section 033000 "Cast-in-Place Concrete."

3.4 INSTALLATION OF INDIVIDUAL GROUND-MOUNTING LUMINAIRES

A. Install on concrete base with top 4 inches (100 mm) above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 CORROSION PREVENTION

A. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.6 GROUNDING

A. Ground metal poles and support structures according to Section 260526 "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.

3.7 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.

1. Verify operation of photoelectric controls.

C. Illumination Tests:

1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IESNA testing guide(s):
   a. IESNA LM-5, "Photometric Measurements of Area and Sports Lighting Installations."
   b. IESNA LM-50, "Photometric Measurements of Roadway Lighting Installations."
   c. IESNA LM-52, "Photometric Measurements of Roadway Sign Installations."
   d. IESNA LM-64, "Photometric Measurements of Parking Areas."
   e. IESNA LM-72, "Directional Positioning of Photometric Data."

D. 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 26 56 00

SECTION 27 00 00 – BASIC COMMUNICATION REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 27, and is intended to supplement, not supersede, the requirements specified in Division 01.

B. The requirements described herein include the following:

1. References
2. Definitions
3. System Description and Project Conditions
4. Submittals
5. Quality Assurance
6. Delivery, Storage, and Handling
7. Scheduling
8. Warranty
9. Product Substitutions
10. Project Management and Coordination Services
11. Permits and Inspections
12. Field Quality Control
13. Project Closeout and Record Documents

C. Related Items

1. General and Supplementary Conditions: General provisions of Contract and Division 01 apply to Division 27.
2. Consult other Divisions and Sections, determine the extent and character of related work, and coordinate Work of Division 27 with that specified elsewhere to produce a complete and operable installation.
3. Section 270811 – Communication Twisted Pair Testing

4. Section 270821 – Communication Optical Fiber Testing

5. Section 271100 – Communication Equipment Rooms

6. Section 271324 – Communication Backbone OSP Optical Fiber Cabling

7. Section 271513 – Communication Horizontal Twisted Pair Cabling

1.2 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.

2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work and furnish materials and equipment under Division 27 in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. California Code of Regulations (CCR):

   a. Title 8, “Industrial Relations”
      1) Chapter 3.22, “California Occupational Safety and Health Regulations (CAL/OSHA)”

   b. Title 24, “California Building Standards Code”
      1) Part 1, “California Building Standards Administrative Code”
      2) Part 2, Volumes 1 and 2, “California Building Code” (CBC)
      3) Part 3, “California Electrical Code” (CEC)
      4) Part 11, “California Green Building Standards Code” (CALGeen)”

2. National Fire Protection Agency (NFPA)

   a. NFPA 70, “National Electrical Code” (NEC)

   b. NFPA 75, “Protection of Information Technology Equipment”

c. NFPA 262, “Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces”, 2007

3. United States Department of Labor (DOL) Occupational Safety and Health Administration (OSHA) Regulations (Standards - 29 CFR)

a. Part 1910, “Occupational Safety and Health Standards”

b. Part 1926, “Safety and Health Regulations for Construction”

4. Code of Federal Regulations (CFR) Title 47 “Telecommunication”, Chapter I “Federal Communications Commission (FCC)”:

a. Part 15, Radio Frequency Devices and Radiation Limits

b. Part 24, Personal Communications Services

c. Part 27, Miscellaneous Wireless Communications Services

5. International Code Council

a. International Building Code (2009)

b. International Fire Code (2009)

c. ICC Performance Code (2009)

6. Other national, state, and local binding building and fire codes

C. Standards: Perform Work and furnish materials and equipment under Division 27 in accordance with the latest editions of the following standards as applicable:

1. Underwriters Laboratories (UL): Applicable listing and ratings, including but not limited to the following standards:

a. UL 444, “Communications Cables”

b. UL 497, “Protectors for Paired-Conductor Communication Circuits”

c. UL 497A, “Secondary Protectors for Communications Circuits”

d. UL 497B, “Protectors for Data Communications and Fire-Alarm Circuits”

e. UL 497C, “Protectors for Coaxial Communications Circuits”

f. UL 1651, “Optical Fiber Cable”

g. UL1655, “Community-Antenna Television Cables”

h. UL 1666, “Test for Flame Propagation Height of Electrical and Optical-Fiber Cables Installed Vertically in Shafts “

i. UL 1690, “Data-Processing Cable “

j. UL 1963, “Communications-Circuit Accessories”

k. UL 2024A, “Optical Fiber Cable Routing Assemblies”

2. ANSI/TIA/EIA-568 Series:

a. ANSI/TIA-568-C.0-2009, “Generic Telecommunications Cabling for Customer Premises”

b. ANSI/TIA-568-C.1-2009, “Commercial Building Telecommunications Cabling Standards - Part 1 General Requirements”

c. ANSI/TIA-568-C.2-2009, “Balanced Twisted Pair Telecommunications Cabling and Components”

d. ANSI/TIA-568-C.3-2008, “Optical Fiber Cabling Components”

3. ANSI/TIA-569-B, “Commercial Building Standard for Telecommunications Pathways and Spaces”

4. ANSI/TIA/EIA-598-B, “Optical Fiber Cable Color Coding”

5. ANSI/TIA/EIA-606-A, “Administration Standard for Commercial Telecommunications Infrastructure”

6. ANSI/J-STD-607-A, “Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications”

7. ANSI/TIA/EIA-758, “Customer-Owned Outside Plant Telecommunications Cabling Standard”, including the following addenda”

a. TIA/EIA-758-1 Addendum No. 1

8. ANSI/TIA-1005, “Telecommunications Infrastructure Standard for Industrial Premises”

9. EIA testing standards

10. Insulated Cable Engineers Association (ICEA):

a. ANSI/ICEA S-80-576-2002, “Category 1 and 2 Individually Unshielded Twisted Pair Indoor Cables for Use in Communications Wiring Systems”

b. ANSI/ICEA S-83-596-1994, “Fiber Optic Premises Distribution Cable”

c. ANSI/ICEA S-87-640-1999, “Fiber Optic Outside Plant Communications Cable”

d. ANSI/ICEA S-90-661-2002, “Category 3, 5, and 5e Individually Unshielded Twisted Pair Indoor Cable for Use In General Purpose and LAN Communication Wiring Systems”

e. ICEA S-102-700-2004, “ICEA Standard For Category 6 Individually Unshielded Twisted Pair Indoor Cables (With Or Without An Overall Shield) For Use In Communications Wiring Systems Technical Requirements”

f. ICEA S-104-696-2001, “Indoor-Outdoor Optical Cable”

11. Building Industry Consulting Services International (BICSI) :

a. Telecommunications Distribution Methods Manual (TDMM)

b. Customer-Owned Outside Plant Design Manual

c. Wireless Design Reference Manual (WDRM)

d. Network Design Reference Manual (NDRM)

D. Make a copy of each document readily available during the course of construction for reference by field personnel.

1.3 DEFINITIONS

A. The Definitions of Division 01 shall apply to Division 27 sections.

B. In addition to those Definitions of Division 01, the following list of terms as used in this specification defined as follows:

1. “As directed”: As directed or instructed by the Owner, or their authorized representative

2. “Cabling”: A system comprised of cables, wire, cords, and connecting hardware [e.g., cables, termination apparatus, patch panels, blocks, connectors, outlets, labeling, etc]

3. “Connect”: To install required patch cords, equipment cords, crossconnect wire, etc. to complete an electronic or optical signal circuit

4. “Cord”: a length of cordage having connectors at each end. The term “Cord” is synonymous with the term “Jumper” and “Lead”

5. “Engineer”: TEECOM

6. “Furnish”: To purchase, procure, acquire, and deliver complete with related accessories

7. “Identifier”: A unique code assigned to an element of the Telecommunications infrastructure that links it to its corresponding record

8. “Install”: To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Make installation complete and ready for regular operation

9. "NIC": Not In Contract (work or equipment)

10. "OFE": Owner Furnished Equipment

11. “Pigtail”: a length of cordage having connectors at one end

12. “Provide”: To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation

1.4 SYSTEM DESCRIPTION AND PROJECT CONDITIONS

A. In circumstances where the Specifications and Drawings conflict, the Drawings shall govern quantity and the Specifications shall govern quality.

1.5 SUBMITTALS

A. Submit required submittals to the General Contractor/Architect in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Failure to comply with requirements in part or whole shall constitute grounds for rejection.

C. Resubmittals: For resubmittals, provide a cover letter with the resubmittal that lists the action taken and revisions made to each product in response to Submittal Review Comments (submitted by Engineer). Lack of this actions-taken cover letter shall constitute grounds for non-review and/or rejection of resubmittal packages.

D. Submittal Description: Product Data

1. Obtain written approval from the Engineer for the product data submittal prior to materials and equipment purchase order and prior to installation.

2. Quantity and Media: Submit product data as described in Division 01. In the absence of requirements given, submit product data submittal as directed in writing either as an electronic submittal (preferred) via approved means (email, FTP upload, CD-ROM, DVD) or as four printed submittals.

3. Format and Organization – Electronic Submittal:

a. File format shall be PDF, either as a single compiled PDF file or as a PDF binder. PDF files should be produced from original electronic media, not scans of printed media. If scans from prints are the only option, annotate electronically, not on the prints prior to scanning.

b. Pages shall be letter size (8.5” x 11”)

c. Organize the Content in the following order:
   1) Cover
   2) Table of Contents (TOC)
   3) Statement of Compliance
   4) Product Information
   5) Seismic Calculations (as required)

d. Clearly and precisely indicate the submitted product and accessories by part number using an electronic annotation (arrow, rectangle, oval, etc.). Where the product data presents “part number builds”, list the exact part number of the submitted products and accessories.

e. Add page numbers in numerical order with no gaps to each page that correctly correspond to the TOC.

f. If submitting via CD-ROM, the disc shall contain all the Cover information.

4. Format and Organization – Printed Submittal:

   a. Paper shall be letter size (8.5” x 11”).

   b. Package printed submittal using a 3-ring binder, clear-front report cover, or similar.
      1) For 3-ring binders, clearly label the cover and spine of each binder with the required “Cover” information (e.g., insert the cover in the front and spine transparent pockets):

   c. Organize the Content in the following order:
      1) Cover
      2) Table of Contents (TOC)
      3) Statement of Compliance
      4) Product Information
      5) Seismic Calculations (as required)

   d. Include tabbed separators for improved navigation through the submittal.

   e. Clearly, precisely, and permanently indicate the submitted product and accessories by part number using an arrow stamp or other permanent indicator. Where the product data presents “part number builds”, indicate the exact part number of the submitted products and accessories.

5. Content:

   a. Cover: Include a cover that clearly displays the following information:
      1) Owner name
      2) Project name and address

3) Submittal name (e.g., “Product Data Submittal for Telecommunications Equipment Rooms”)
4) Project submittal number
5) Contractor’s submittal number (discretionary)
6) Submittal date; format: Month Day, Year (e.g., “January 1, 2010”)
7) Specification section numbers included in the submittal (e.g., “Section 271100”)
8) Contractor name and contact information

b. Table of Contents (TOC): Include a TOC that lists materials by section number, article and paragraph number. Add a brief product description (what it is, size or color or other optional features), manufacturer and part number. List the submittal page number per product. Example heading for TOC:

Section	Article	Paragraph	Description	Manufacturer	Part #	Page #

c. Statement of Compliance: Include a “Statement of Compliance” letter or memorandum on the submitter’s company letterhead from the highest ranking employee assigned to this project stating the submittal has been reviewed (quality control check) and is in full compliance with the requirements of the Contract Documents, and listing the submittal’s contents. Wet sign (and stamped, if applicable) the letter.

d. Product Information: Include manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary) that clearly describe the product’s characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color and finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Include products listed in the specifications, at a minimum. Include relevant products that will be installed, which are not listed in the specifications.

e. Seismic Calculations: Include anchorage calculations for equipment (such as floor mounted equipment racks/frames/cabinets, overhead cable support/pathways, video display equipment, etc.) such that it shall remain attached to the mounting surface after experiencing forces in conformance with the CBC for Seismic Zone 4 Area, Importance Factor of 1.25. Specify proof loads for anchors. A Structural Engineer registered in the State of California shall prepare structural calculations, and shall wet stamp and sign them. Submit structural calculations to the City of Industry for review and approval.

E. Submittal Description: Shop Drawings

1. Prior to the start of work, submit shop drawings and obtain written approval from the Owner for the shop drawings submittal.

2. Quantity and Media: Submit shop drawings as described in Division 01. In the absence of requirements given, submit shop drawings as directed in writing either an electronic submittal (preferred) via approved means (email, FTP upload, CD-ROM, DVD) or four printed and bound sets on bond.

3. Format:

   a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

   b. Use the same sheet size as the drawings of the Contract Documents.

   c. Use the project's title block – same as the drawings of the Contract Documents.

   d. Text: 3/32" - 1/8" high when plotted at full size.

   e. Use identical symbols as those in the drawings.

   f. Screen background information.

   g. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.

   h. Scaling:
      1) Scale floor plans at 1/8"=1'-0"
      2) Scale enlarged room plans at 1/4"=1'-0"
      3) Scale wall elevations at 1"=1'-0"
      4) Scale rack elevations at 1"=1'-0"

4. Content:

   a. Cover Letter: Accompany each shop drawing submittal with a cover letter stating that the shop drawings have been thoroughly reviewed by the Contractor and are in full compliance with the requirements of the Contract Documents. Have the person who prepared the submittal sign (and stamped, if applicable) the cover letter and include a drawing index. Failure to comply with this requirement shall constitute grounds for rejection of submittal.

   b. Drawings: Shop drawing submittals shall consist of symbols list, point-to-point diagrams, block diagrams, riser diagrams, line diagrams, floor plans, enlarged room plans, wall and rack elevations, installation details, and other aspects of the system. Include detailed labeling examples for cables, outlets, termination apparatus, devices, equipment, etc.

   c. Seismic Calculations: Include anchorage calculations for equipment (such as floor mounted equipment racks/frames/cabinets, overhead cable support/pathways, video display equipment, etc.) such that it shall remain

attached to the mounting surface after experiencing forces in conformance with the CBC for Seismic Zone 4 Area, Importance Factor of 1.25. Specify proof loads for anchors. A Structural Engineer registered in the State of California shall prepare structural calculations, and shall wet stamp and sign them. Submit structural calculations to the City of Industry for review and approval.

F. Submittal Description: As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 01. In the absence of requirements given, submit as-built drawings as directed in writing as electronic files via CD-ROM or DVD and four printed and bound sets on bond.

2. Format:

   a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

   b. Use the same sheet size as the drawings of the Contract Documents.

   c. Use the project's title block – same as the drawings of the Contract Documents.

   d. Text: 3/32" - 1/8" high when plotted at full size.

   e. Use symbols identical to the symbols shown on the Drawings.

   f. Screen background information.

   g. Plot system components (symbols, outlet, devices, pathways, cable routes, etc.) and text using a heavier line weight sufficient enough to stand out against background information.

   h. Electronic files shall be native format and plotted PDF files. The file names shall include the sheet number.

3. Content:

   a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.

   b. Symbols List

   c. Diagrams, such as (but not limited to) point-to-point diagrams, block diagrams, riser diagrams, line diagrams, and other diagrams that conceptually describe the system

   d. Floor Plans: Scale plans at 1/8"=1'-0". Plans shall show:
      1) Locations and identifiers of telecommunications outlets
      2) Routes, types, sizes, and quantities of pathways (such as cable trays, basketway, conduits, hangers, and other pathways)

e. Enlarged Rooms Layouts: Applicable rooms: Data Center, Network Patching Facility, Server Room, PBX Equipment Room, Entrance facilities, MTR, TRs, MDF, BDFs, IDFs. Room drawings shall show:
   1) Floor layouts – scaled at 1/2”=1’-0”, showing dimensioned placement of equipment cabinets/frames, rack bays, etc.
   2) Overhead layouts – scaled at 1/2”=1’-0”, showing dimensioned placement of overhead cable support (e.g., cable tray, cable runway, basketway, conduit sleeves, etc.)
   3) Rack elevations – scaled at 1”=1’-0”, showing placement of termination apparatus and other equipment installed onto rack bays
   4) Wall Elevations – scaled at 1”=1’-0”, showing dimensioned placement of termination apparatus (e.g., termination/crossconnect blocks)

G. Submittal Description: Operation and Maintenance (O&M) Manual

1. Quantity and Media: Submit O&M Manual as described in Division 01. In the absence of requirements given, submit one packaged O&M Manual set.

2. Format and Organization:

   a. Include contents in a 3-ring binder with front cover and spine clear pockets for insertion of the Cover information.

   b. Cover shall include the following information:
      1) Owner Name
      2) Project Name and Address
      3) Manual Name (e.g., “Operation and Maintenance Manual for Telecommunications Cabling System”)
      4) Date; format: Month Day, Year (e.g., “January 1, 2010”)
      5) Contractor name and contact information

   c. Include a Table of Contents at the beginning that lists the contents.

   d. Include tabbed separators for improved navigation through the manual.

3. Content:

   a. As-built drawings, as described above, printed on tabloid size (17”x11”) paper

   b. As-built drawings, as described above, as electronic files – both native files and plotted PDF files, on CD-ROM

   c. Product catalog/technical information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal), printed on letter size (8.5” x 11”) paper

   d. Product catalog/technical information sheets for each component provided, as PDF files on CD-ROM

e. Warranty certificate from the manufacturer and the Contractor, printed on letter size (8.5” x 11”) paper, wet signed as applicable

f. Manufacturer’s instructions for system or component use

g. Instructions and requirements for proper maintenance (according to the manufacturer) and as to maintain warranty

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications

1. Five continuous years, minimum, design and manufacture of the materials and equipment specified herein.

2. Manufacturer(s) of products and equipment specified herein shall demonstrate that they have a quality assurance program in place to assure that the specifications are met. Include in the program, at a minimum, provisions for:

a. Incoming inspection of raw materials

b. In-process inspection and final inspection of the cable product

c. Calibration procedures of test equipment to be used in the qualifications of the product

d. Recall procedures in the event that out of calibration equipment is identified.

3. Conform to government standards on quality assurance for applications within these specifications.

B. Contractor Qualifications

1. A current, active, and valid and C7 or C10 California State Contractors License

2. Five, minimum, continuous years experience

3. Five, minimum, completed projects similar to scope and cost

4. Evidence of technicians qualified for the work

C. Materials

1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials

2. Use specified products and applications, unless otherwise submitted and approved in writing.

D. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 27 shall confirm to the most stringent of the applicable codes.

2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

E. Drawings

1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.

2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.

3. The Drawings do not fully represent the entire installation for the Communications System. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery

1. Do not deliver products to the site until protected storage space is available.

2. Coordinate materials delivery with installation schedule to minimize storage time at jobsite.

3. Deliver materials in manufacturer's original, unopened, undamaged packaging and containers with identification labels (name of the manufacturer, product name and number, type, grade, UL classification, etc.) intact.

4. Immediately replace equipment damaged during shipping at no cost to the Owner, so as not to impact the construction schedule.

B. Storage and Protection

1. Store materials in clean, dry, ventilated space free from temperature and humidity conditions (as recommended by manufacturer) and protected from exposure to harmful weather conditions.

2. Comply with manufacturer's storage requirements for each product. Comply with recommended procedures, precautions or remedies as described in the Material Safety Data Sheets (MSDS) as applicable.

3. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.

4. Storage outdoors covered by rainproof material is not acceptable.

5. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle materials and equipment in accordance with manufacturer's written instructions. Handle with care to prevent damage, breakage, denting, and scoring.

2. Do not install damaged materials and equipment. Replace damaged equipment at no cost to the Owner.

1.8 SCHEDULING

A. Unless otherwise specified, the construction schedules of the Sections within Division 27 may be combined into a single, overall schedule.

B. Do not proceed without written approval from the Owner or Owner's Representative for schedule of this Work.

1.9 PROJECT MANAGEMENT AND COORDINATION

A. Role of the Engineer

1. The Owner has retained the Engineer's services through construction. During construction, the Engineer will work with and assist the Contractor as follows (in general:

a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.

b. Provide interpretation and clarification of project contract documents

c. Reply to (and 'process') relevant Requests for Information (RFIs)

d. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.

e. Interpret field problems for Owner, and translate between Owner and Construction Team.

f. Review the testing procedures to confirm compliance with industry-accepted practices.

g. Observe the work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system, and report progress to the Owner,

B. Use of CAD Files

1. Should the Contractor require the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

1.10 WARRANTY

A. Warrant products and labor provided will, under normal use and service, be free from defects and faulty workmanship for period of 1 year from the date of acceptance. During the warranty period the entire system shall be kept in operating condition at no additional material or labor costs to the Owner.

B. Render service within 24 hours of system failure notification. Note deviations or improvements to this service at the time of bid and obtain written acceptance from the Owner, or Owner's Representative.

C. Manufacturers of the major system components shall maintain a replacement parts department and provide testing equipment when needed. Provide complete replacement parts within a 24-hour period during the warranty period.

D. Conformance to certain government standards on quality assurance may be required for some applications outlined in these specifications.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials used shall present no environmental or toxicological hazards as defined by current industry standards and shall comply with OSHA and EPA standards, other applicable federal, state, and local laws.

B. Product numbers are subject to change by the manufacturer without notification. In the event a product number is invalid or conflicts with the written description, notify the Owner's Representative in writing prior to ordering the material and performing installation work.

2.2 SUBSTITUTIONS

A. Conform to the general requirements and procedure outlined in Division 01 in the Request For Substitution.

B. Only one substitution allowed for each product specified.

C. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data –required to substantiate that the product is in fact equivalent to that specified. The burden of proof that the substituted product is

equivalent to the specified product rests with the Contractor. Whenever material, process or equipment is specified in accordance with an industry specification (ANSI, TIA, etc), UL rating, or other association standard, present an affidavit from the manufacturer certifying that the product complies with the particular standard specification. When requested by the Engineer, submit supporting test data to substantiate compliance.

D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the work, or from provisions of the specifications.

G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 PERMITS AND INSPECTIONS

A. Obtain and pay for permits and inspections required for the work.

B. Furnish materials and execute workmanship for this work in conformance with applicable legal and code requirements.

C. Perform tests required herein, or as may be reasonably required to demonstrate conformance with the Specifications or with the requirements of legal authority having jurisdiction.

D. Arrange and pay for review/inspection from compliance officials responsible for enforcement of applicable codes and regulations to establish that the work is in compliance with requirements of reference codes indicated herein.

3.2 EXAMINATION

A. Verify existing conditions, stated under other sections, are acceptable for installation in accordance with manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman to supervise the crew performing the work and who is present at the job site at times work is being performed.

B. Construction Meetings: Participate in construction coordination meetings throughout the course of construction to review the progress and to resolve issues and conflicts. Prepare and distribute meeting agenda for telecommunication issues prior to, and meeting notes after meetings, in a format acceptable to the Owner. Publish meeting notes within 3 business days following the meeting.

C. Scheduling: Perform the work within the approved construction schedule. Keep the construction schedule current, based on the results of the construction meetings. At minimum, schedule shall document critical due dates, tasks, and milestones. Submit revised schedules for approval within 3 business days whenever there are modifications.

D. Inspection: Inspect the work after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion and inspection as required.

3.4 INSTALLATION

A. Complete work in a neat, high-quality manner, relative to common industry practices, and in accordance to NECA “Standard of Installation”.

B. Complete work in conformance to applicable federal, state and local codes, and telephone standards.

C. Coordinate the entire installation throughout the construction team (general contractor and subcontractors).

D. Manufacturer's Instructions:

1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite packaged with an MSDS.

E. Adjusting:

1. Make changes and revisions to the system to optimize operation for final use.

2. Make changes to the system such that defects in workmanship are corrected and cables and the associated termination hardware pass the minimum test requirements.

F. Protection

1. Protect installed products and finish surfaces from damage during construction.

G. Repair/Restoration

1. Replace or repair work completed by others that you deface or destroy. Pay the full cost of this repair/replacement.

2. Repair defects prior to system acceptance.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused, excess, and left over products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's, or Owner's Representative's, punch walk.

3.6 FINAL INSPECTION AND CERTIFICATION

A. Punch Walks and Punch Lists

1. Punching the Work of individual Sections of Division 27 may be combined.

2. Execute a punch walk with the Engineer and the Owner's Representative to observe Work.

3. Develop a punch list for items needing correction. Issue this punch list to Engineer.

4. Correct the Work as noted on punch list.

5. Execute follow up punch walk with the Engineer and the Owner's Representative to verify punch list items have been corrected.

B. System Acceptance

1. Complete corrections (punch list items) prior to submitting acceptance certificate.

2. On completion of the acceptance test, submit system acceptance certificate to the Owner's Representative requesting their signature and return of the certificate. Issue copies of the signed certificate back to the Owner's Representative with copy to the Engineer.

C. Training

1. After acceptance, schedule a time convenient with the Owner, or Owner's Representative, for instruction in the configuration, operation, and maintenance of the system.

2. Refer to individual sections within Division 27 for additional training requirements.

END OF SECTION 27 00 00

SECTION 27 08 11 – COMMUNICATIONS TWISTED PAIR TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of Communications Twisted Pair Cabling (Horizontal Cabling).

B. Related Sections

1. Comply with the Related Sections paragraph of Section 270000.

2. Section 271513 - Communication Horizontal Twisted Pair Cabling

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition to the References of Section 270000, the following references apply to this specification:

1. ANSI/TIA-1152, “Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling”

1.3 DEFINITIONS

A. Refer to Definitions of Section 270000 and Section 271513.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:

1. “CAT5E”: Shall mean Enhanced Category 5 cabling, per ANSI/TIA-568-C.2

2. “Channel”: Shall mean a testing configuration which includes the Permanent Link and the line cord (at the workstation), the equipment cord, and, if a full crossconnection is implemented, a patch cord and the crossconnect termination/connecting apparatus.

3. “Connect”: Shall mean install all required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.

4. “Cord”: Shall mean a length of cordage having connectors at each end. The term “Cord” is synonymous with the term “Jumper” and “Lead”.

5. “Permanent Link”: Shall mean the ‘permanent’ portion of the Horizontal cabling to each outlet with the test cords de-embedded from the measurements; this includes cable, consolidation point (if used), termination/connecting apparatus in the IDF and the connector at the outlet.

6. “System Cord”: Shall mean the cord used in the operating transmission circuit.

7. “Test Cord”: Shall mean the cord certified for use in testing, as described in this section.

1.4 SYSTEM DESCRIPTION

A. Refer to Section 270000 and Section 271513 for addition system description information.

B. Work Provided Under Other Sections

1. Horizontal twisted pair cabling

C. Base Bid Work

1. Testing of a completed communication infrastructure cabling system, which includes:

a. Submittals

b. Testing of the twisted pair cabling as follows:

Table 270811-1.1: Tests For UTP Cabling

Subsystem	Type	Test	Configuration	Notes
Horizontal	CAT5e	Category 5e	Permanent Link	Per TIA-568-C.2, 6.3

c. Record Documents, including test results.

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 270000.

B. Submittal Requirements at Start Of Construction:

1. Testing Procedures Submittal, describing step-by-step procedures used by the field technicians.

2. Product Submittal, including cut sheets of testing equipment to be used (note all software/ firmware versions as applicable).

3. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.

C. Submittal Requirements at Closeout:

1. Record Documents:

a. Submit one hard copy and one soft copy of test reports, including all tested parameters. This may be combined with the reports of Section 270821.

b. Submit one hard copy of warranty certificate.

2. Format – Hard Copy:

a. Prints of test reports, on 8.5”x 11” paper, color or black & white, one cabling link per page

b. Assemble prints into a 3-ring binder

c. Clearly label the cover of each test reports binder with the following information:
   1) Client Name
   2) Project Name and Address
   3) Binder Name (e.g., “Test Reports for Horizontal Cabling System”)
   4) Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2012”)
   5) Contractor Name

d. Include a Table Of Contents at the beginning that lists the contents

e. Organize the test reports by floor, and by IDF/Enclosure.

f. Sort reports in ascending cable ID order

g. Include tabbed separators for improved navigation through the manual

3. Format – Soft Copy:

a. “Burn” onto one CD-ROM test report files as native data format (for example, an *.FLW file from a Fluke tester); if not possible to submit in native format, then issue test results as an exported Microsoft Excel compatible format.

b. Include onto CD-ROM ‘Viewer’ software necessary to view, sort, filter, and print individual and summary test results from test results native format.

c. Clearly label the CD-ROM with the following information:
   1) Client Name
   2) Project Name and Address
   3) CD-ROM Name (e.g., “Test Reports for Horizontal Cabling System”)

4) Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2012”)
5) Contractor Name

1.6 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 270000.

B. Under no circumstances shall any cable’s and/or conductor’s test results be substituted for another’s. If an instance of falsification is confirmed, the Contractor is liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.7 WARRANTY

A. Warrant the validity of the test results.

PART 2 - PRODUCTS

2.1 CATEGORY 5E HORIZONTAL CABLE TESTER

A. Equipment shall be independently verified to meet ANSI/TIA-1152 requirements, including Level IIe minimum accuracy. Equipment shall meet ISO/IEC Class C and D.

B. Test Standards (minimum): ANSI/TIA-568-C.2 Category 5e; ISO/IEC 11801 Class C and D; ISO/IEC 11801-2000 Class C and D, 1000Base-T, 100Base-TX; IEEE 802.3 10Base-T; ANSI TP-PMD; IEEE 802.5

C. Areas of Test Measurement (minimum): test areas listed under ANSI/TIA568-C.2, 6.3

D. Equipment

1. Agilent Technologies “WireScope 350” test unit, with “ScopeData” reporting and documentation software (version 5.20, or higher)

2. Fluke Networks “DSP-4300 CableAnalyzer” test unit, with “CableManager” reporting and documentation software (version 4.8, or higher)

3. Or product similar in design, construction, and performance.

PART 3 - EXECUTION

3.1 SCHEDULING

A. Prepare a construction schedule based on the schedule developed in sections 271513 for the testing activities. Update testing schedule when changes in the cabling schedules occur.

3.2 FIELD QUALITY CONTROL

A. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

B. Ensure test equipment and test cords are clean and undamaged during testing activities. Per the Engineer's discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

3.3 HORIZONTAL CATEGORY 5E TESTING PROCEDURES

A. Precautions

1. Adhere to the equipment manufacturer's instructions during all testing.

2. Prior to any testing activity or any measurements taken, ensure the test equipment is at room temperature – approximately 70 degrees F (e.g., if necessary, bring the test equipment in from outdoors and let it set for about 15 minutes or for however long it takes to bring the test equipment to reach room temp).

3. Fully charge power sources before each day's testing activity

B. Test Equipment Set Up

1. Set up the tester to perform a full CAT5e test, as a Permanent Link configuration.

2. If the tester has the capability, set the cable type as product specific setting. If not, set as generic CAT5e.

3. Set the tester to save the full test results (all test points, graphs, etc.).

4. Save the test results with the associated cable link identifier.

5. Calibrate the test set per the manufacturers instructions.

C. Acceptable Test Result Measurements

1. Overall Test Results:

a. Links which report a Fail, Fail* or Pass* for any of the individual tests shall result in an overall link Fail. All individual test results must result in a Pass to achieve an overall Pass.

b. Any reconfiguration of link components required as a result of a test Fail, must be re-tested for conformance.

c. Remove and replace any cabling links failing to meet the criteria described in this specification, at no cost to the Owner, with cables that prove, in testing, to meet the minimum requirements.

2. Wire Map: Provide continuous pairs and terminate all of the cabling link correctly at both ends. No exceptions accepted.

3. Length: Ninety-four meters is the maximum acceptable electrical length measurements for any cabling link measured under a Permanent Link configuration, including test cords.

4. Insertion Loss: The acceptable insertion loss measurements for any CAT5e cabling link is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

5. Worst Pair-to-Pair Near End CrossTalk (NEXT) Loss: The acceptable worst pair-to-pair NEXT loss for any CAT5e cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

6. Power Sum NEXT Loss: The acceptable power sum PS-NEXT loss for any CAT5e cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

7. Worst Pair-to-Pair ELFEXT and FEXT Loss: The acceptable worst pair-to-pair ELFEXT and loss for any CAT5e cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

8. Power Sum ELFEXT and FEXT Loss: The acceptable PS-ELFEXT and loss for any CAT5e cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

9. Return Loss: The acceptable return loss measurements for any CAT5e cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

10. Propagation Delay and Delay Skew: The acceptable propagation delay and delay skew measurements for any CAT5e cable is that which is no greater than that listed in ANSI/EIA-568-C.2, 6.3.

D. Record Documents:

1. Permanently record test results.

2. Export all of the numerical test results to a single spreadsheet in Microsoft Excel® 2003 (*.xls) or 2007 (*.xlsx) file format.

3. Submit test results at the conclusion of the testing to the Engineer for approval. Engineer will check these test reports for a format acceptable to the Owner, or Owner's Representative.

4. For each Horizontal CAT5e test, record the following information:

   a. Project name and address

   b. Testing Company's and Operator's name

   c. Date of measurement

   d. Test equipment, including the following:
      1) Manufacturer, model, and serial number
      2) Date and time of last calibration

   e. Identification number of cable

   f. Overall test result

END OF SECTION 27 08 11

SECTION 27 08 21 – COMMUNICATIONS FIBER OPTIC TESTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Testing of Telecommunications Backbone Fiber Optic Cabling.

B. Related Sections

1. Comply with the Related Sections paragraph of Section 270000.

2. Section 271324 - Communication Backbone OSP Fiber Optic Cabling

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In addition, the following standards are referenced to this Section:

1. TIA/EIA-526-14A (OFSTP-14), “Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant”

2. TIA/EIA-526-7 (OFSTP-7), “Measurement of Optical Power Loss of Installed Singlemode Fiber Cable Plant”

3. EIA/TIA-455-77 (FOTP-77), “Procedures To Qualify A Higher-Order Mode Filter For Measurements On Singlemode Fibers”

4. EIA/TIA-455-78A (FOTP-78), “Spectral-Attenuation Cutback Measurement for Singlemode Optical Fibers”

5. EIA-455-95 (FOTP-95), “Absolute Optical Power Test for Optical Fibers and Cables”

6. EIA-455-171 (FOTP-171), “Attenuation By Substitution Measurement – For Short-Length Multimode Graded-Index And Single-Mode Optical Fiber Cable Assemblies”

7. American National Standards Institute (ANSI) Z136.2, “American National Standard for the safe use of optical fiber communication systems utilizing laser diode and LED sources”

8. BICSI Telecommunication Distribution Methods Manual (TDMM)

1.3 DEFINITIONS

A. Refer to Definitions of Section 270000 and Section 271324.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:

1. “Adapter” (associated with fiber connectivity): Shall mean a connecting device that joins 2 fiber connectors, either like or unlike

2. “Connect”: Shall mean install all required test cords, patch cords, system cords, etc. to complete an optical circuit

3. “CPR”: Coupled Power Ratio (according to TIA/EIA-526-14A Annex A

4. “Cord”: Shall mean a length of cordage having connectors at each end; the term “Cord” is synonymous with the term “Jumper”

5. “Jumper”: See “Cord”

6. “OTDR”: Shall mean Optical Time Domain Reflectometer

7. “Passive Link Segment”: Shall mean the cable, connectors, couplings, and splices between two fiber optic termination units

8. “System Cord”: Shall mean the cord used in the operating electrical or optical circuit.

9. “Test Cord”: Shall mean the cord certified for use in testing, as described in this section

1.4 SYSTEM DESCRIPTION

A. Refer to Section 270000 and 271324 for addition system description information.

B. Work Provided Under Other Sections

1. Backbone fiber optic cabling

C. Base Bid Work

1. Submittals: pre-testing and post-testing

2. Testing of completed fiber optic passive link segment(s) per the following table:

Table 270821-1.1: Tests For Fiber Optic Cabling

Subsystem	Type	Test	Direction	Wavelength
Backbone	Multimode	Optical Power Loss	Both	850nm and 1300nm

3. Record Documents, including test results

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 270000.

B. Submittal Requirements at Start Of Construction:

1. Testing Procedures Submittal: Describe step-by-step procedures used by the field technicians.

2. Pre-Testing Loss Calculations Submittal: Calculate the loss of each segment. The cable length may be based on the footage markings printed on the cable jacket. Include a brief description of each segment.

3. Product Submittal, including cut sheets of testing equipment and the following information (*this data must match the test reports*):

a. Manufacturer and model number

b. Serial number

c. Date of last factory calibration

d. Software/ firmware versions (as applicable)

4. Schedule Submittal, consisting of proposed schedule of work (this schedule may be combined with the schedule developed for Division 27)

C. Submittal Requirements at Closeout:

1. Submit test results and reports in a format acceptable to the Owner, or Owner's Representative, or Engineer before system acceptance.

2. Submit one soft copy and one hard copy of test reports, including all tested parameters. This may be combined with the reports of Section 270811.

3. Submit one hard copy of warranty certificate from the manufacturer and the Contractor

4. Each test report (per strand per cable link) shall include the following information:

a. Project/Client name, and project address

b. Date of test

c. Contractor (Company) and Technician's name

d. Test equipment, including Serial Numbers (*must match pre-testing submittal*)

e. Test procedure (e.g., OFSTP-14A) and method (e.g., Method B)

f. Light source's launch category (including CPR) and spectral width

g. Wavelength

h. Cable identifier, fiber number, and fiber type (e.g., "multimode")

i. Measurement direction, including end locations

j. Optical loss measurement

5. Cable and fiber identifiers of the test reports shall match the identifiers as labeled in the field – i.e., the ID stored with the test result shall be the same ID as on the cable label/fiber port label.

6. Format – Soft Copy:

   a. "Burn" onto one CD-ROM test report files as native data format (for example, an *.FLW file from a Fluke tester). If not possible to submit in native format, then issue test results as an exported Microsoft Excel compatible format.

   b. Include onto CD-ROM (or separate CD-ROM) 'Viewer' software necessary to view, sort, filter, and print individual and summary test results from test results native format.

   c. Clearly label the CD-ROM with the following information:
      1) Owner Name
      2) Project Name and Address
      3) CD-ROM Name (e.g., "Test Reports for Backbone Cabling System")
      4) Date of Submittal – date format: <month> <day>, <year> (e.g., "January 1, 2010")
      5) Contractor Name

7. Format – Hard Copy of Optical Loss Testing:

   a. Prints of test reports, on 8.5"x 11" paper, color or black & white, one cabling link per page

   b. Assemble prints into a 3-ring binder

c. Clearly label the cover of each test reports binder with the following information:
   1) Owner Name
   2) Project Name and Address
   3) Binder Name (e.g., “Test Reports for Backbone Cabling System”)
   4) Date of Submittal – date format: <month> <day>, <year> (e.g., “January 1, 2010”)
   5) Contractor Name

d. Include a Table Of Contents at the beginning that lists the contents

e. Organize the test reports by Backbone Cabling / Horizontal Cabling, by building, by floor, and by IDF/Enclosure.

f. Sort reports in ascending cable ID order

g. Include tabbed separators for improved navigation through the manual

1.6 QUALITY ASSURANCE

A. Comply with the Quality Assurance requirements of Section 270000.

B. Testing equipment shall be fully functional and in proper working order. Testing equipment shall be factory calibrated within the manufacturer’s published calibration period. Testing equipment must have loaded the latest firmware / operating software.

C. Under no circumstances shall any cable’s and/or optical conductor’s test results be substituted for another’s. If an instance of falsification is confirmed, the Contractor will be liable for a complete retest of the cabling system at no additional cost to the Owner. This includes the retaining the services of a neutral party to observe all retesting.

1.7 WARRANTY

A. Warrant the validity of the test results. Issue such warranty in writing.

PART 2 - PRODUCTS

2.1 FIBER OPTIC LIGHT SOURCE

A. Light source used for testing multimode fibers shall confirm to TIA/EIA-526-14A, 3.1. Light source used for testing singlemode fibers shall confirm to TIA-526-7, 3.1.1.

B. Light source’s modal launch condition shall be Category 1.

C. Light source’s connection interfaces shall be factory installed. Field-configurable connection interface will not be allowed.

D. Light source's output wavelength and power shall be constant/unchanged after setting.

E. Light source shall be factory calibrated (date of last factory calibration must be documented).

F. Equipment:

1. Corning Cable Systems

a. #OS-403RD; dual wavelength (850 / 1300) light source for multimode

2. Exfo

a. #FOT-930; OLTS test set

b. #FOT-600 OLTS test set (#23BL Source + #602X Meter)

c. #FOT-300; OLTS test set

3. Fluke Networks

a. #DTX-1800; "DTX CAbleAnalyze" Test Kit – or bundled kit

b. #DTX-MFM2 Fiber Module, for Multimode Fiber

c. #DTX-GFM2 Gigabit Fiber Module, for Multimode Fiber

d. "SimpliFiber" Test Kit

2.2 FIBER OPTIC POWER METER

A. Power meters used for testing multimode fibers shall conform to TIA/EIA-526-14A, 3.2. Power meters used for testing singlemode fibers shall conform to TIA/EIA-526-7, 3.1.2.

B. Power meter shall be capable of measuring both relative and absolute power, and shall feature data storage (of measurements).

C. Power meter used shall have the following performance:

1. Dynamic range of 0dBm to -50dBm, minimum

2. Accuracy of ±0.2dB

D. Power meter shall be factory calibrated (date of last factory calibration must be documented).

E. Equipment:

1. Corning Cable Systems

a. #OTS-610; power meter with data storage

b. #OTS-400 series power meter (legacy product series)

2. Exfo

a. #FOT-930; OLTS test set

b. #FOT-600 OLTS test set (#23BL Source + #602X Meter)

c. #FOT-300; OLTS test set

3. Fluke Networks

a. #DTX-1800; “DTX CableAnalyze” Test Kit – or bundled kit

b. #DTX-MFM2 Fiber Module, for Multimode Fiber

c. #DTX-GFM2 Gigabit Fiber Module, for Multimode Fiber

d. “SimpliFiber” Test Kit

2.3 FIBER OPTIC MANDREL

A. For 50/125 µm fiber: 22 mm mandrel diameter for jacketed (3.0 mm) fiber.

B. Equipment:

1. Fluke Networks

a. #NF-MANDREL-50; red mandrel for jacketed 50/125 um fiber

2.4 FIBER OPTIC OTDR

A. Multimode Source Module:

Wavelength	Dynamic Range	Attenuation Deadzone	Reflective Deadzone	Loss Resolution	Distance Accuracy
850nm	24dB	6.5mt	3.0mt	0.001dB	0.1mt
1300nm	27dB	7.0mt	3.0mt	0.001dB	0.1mt

B. Equipment:

1. Corning Cable Systems

a. #OV-1000; OTDR ‘mainframe’

b. #400-MD26; multimode module for OV-1000 OTDR

c. #2001HR; for multimode & singlemode systems (legacy product series)

d. #340 OTDR Plus Multitester II (legacy product series)

e. #MiniOTDR+; for multimode & singlemode systems (legacy product series)

2. Exfo

a. #FTB-500 platform OTDR

b. #FTB-200 platform compact OTDR

3. Fluke Networks

a. #OF-500; “OptiFiber” OTDR mainframe – or bundled kit

b. #OFTM-5610B; Multimode module for OptiFiber OTDR

c. #OFTM-5610B; Multimode module for OptiFiber OTDR

C. Reader Software: Windows-based software capable of reading stored traces and is fully functional with the testing equipment.

2.5 FIBER OPTIC TEST CORDS

A. Multimode Fiber Optic Test Cord

1. Multimode test cords shall conform to TIA-526-14A, 3.3.

2. The fiber of the multimode test cord(s) shall have the core diameter to that of the multimode fiber optic passive link under test.

3. Connectors of the test cords shall be compatible with (the same type as) the connector types of the light source and the power meter, and with the cabling plant.

4. The connectors shall exhibit ≤ 0.5dB loss per connection @ both 850nm and 1300nm, as measured per FOTP-171 D2.

5. Test cord length for Optical Power Loss testing: 1m - 5m.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. Prior to the start of testing, set up a meeting with the Engineer to witness testing procedures. The Engineer will, at their discretion, come to the site and witness the technician’s actual testing procedures. The Engineer may give verbal comments to correct the technician’s procedures to meet these requirements, followed up with a written observation report.

B. Calibrate test sets and associated equipment per the manufacturers printed instructions at the beginning of each day's testing and after each battery charge. Fully charge the test sets prior to each day's testing to ensure proper operation.

C. Use undamaged test equipment and test cords. Clean connectors and adapters (with a lint-free wipe and 90% (or higher) isopropyl alcohol) prior to and during testing activities. Per the Engineer's discretion, halt testing activity and clean testing equipment, test cords, and related apparatus.

D. Permanently record test results.

3.2 OPTICAL POWER LOSS TESTING REQUIREMENTS AND PROCEDURES

A. Safety: Use test equipment containing a laser or LED in accordance with ANSI Z136.2.

B. Test fiber optic passive links per "Base Bid Work" under System Description in Part 1 of this Section. Follow the procedures in the following order.

C. Precautions

1. Adhere to the precautions described in TIA-526-14A, 5.1.

2. Adhere to the equipment manufacturer's instructions during all testing.

3. Prior to any testing activity or any measurements taken:

   a. Ensure test equipment is at room temperature – approximately 72 degrees F (if necessary, bring the test equipment in from outdoors and let it set until the test equipment reaches room temp).

   b. Power on the light source and power meter for at least 5 minutes prior to obtaining measurements.

   c. Clean connectors and adapters with a lint-free wipe and 90% (or higher) isopropyl alcohol.

4. Do not power off the light source or the power meter during testing activity.

5. Do not remove Test Cord #1 from the light source at any time (unless the testing is complete or the equipment is being put away for the evening).

6. Do not bend the test cords smaller than 20 times the cord diameter (this may induce loss into the cord reducing the accuracy of the measurement).

D. Test Cord Performance Verification

1. Connect Test Cord #1 to the light source and to the power meter.

2. Set this value into the power meter as the reference power (P_{ref}).

3. Disconnect Test Cord #1 from the power meter. Do not disconnect Test Cord #1 from the light source.

4. Connect the 'open' end of Test Cord #1 to an adapter (of matching connector type). Connect one end of Test Cord #2 to that adapter and the other end of Test Cord #2 to the power meter.

5. The value displayed on the power meter represents the test cord #2 connection loss.

6. Flip the ends of Test Cord #2 so that the end connected to the power meter is now connected to the adapter (attached to test cord #1), and the end connected to the adapter is now connected to the power meter.

7. The value displayed on the power meter represents the test cord #2 connection loss on the opposite end.

8. Both connection loss measurements must be less than or equal to the value found in Table 270812-3.1 (below). Replace cord if measure losses exceed table values.

Table 270821-3.1: Acceptable Test Cord Connection Attenuation

	ST or SC Connection	LC an other Mini-Connector
Multimode	0.50 dB Max	0.20 dB Max

9. Repeat this test procedure from the beginning reversing the test cords in order to verify the performance of test cord #1.

E. Test Equipment Set Up

1. Follow the test equipment manufacturer's initial adjustment and set up instructions.

2. Set the power meter to Relative Power Measurement Mode

3. Set the meter to display power levels in dBm.

4. Set the light source and power meter to the same wavelength.

F. Multimode Passive Link Insertion Loss Testing Procedures

1. Only use a light source that exhibits a Category 1 modal launch condition. Confirm the light source's modal launch condition following the procedures described in TIA-526-14A, Annex A.

2. Test Method:

   a. For 'permanent' links, perform the optical power loss testing of multimode fibers according to TIA-526-14A test method B "One Jumper Reference".

b. For ‘channel’ links, perform optical power loss testing of multimode fibers according to TIA-526-14A test method C “Three Jumper Reference” and include the system cords as part of the cable plant.

G. Acceptable Measurement Values

1. The measured loss shall not exceed the calculated loss of the pre-testing submittals.

H. Record Test Measurements:

1. Permanently record all test data per strand, including the following (minimum):

a. Project name

b. Cable identifier, fiber number, and fiber type (e.g., “multimode”)

c. Testing company name

d. Testing technician’s name

e. Date measurements were obtained

f. Measurement direction

g. Wavelength

h. Loss measurement

i. Test equipment model and serial number(s)

2. Measurements shall carry a precision through one significant decimal place, minimum.

PART 4 - TESTING FORMS

4.1 SUMMARY OF FORMS

A. Fiber Optic Test Instrument Data Sheet

B. Fiber Optic Reference Power Measurement Method Form

C. Fiber Optic Relative Power Measurement Method Form

END OF SECTION 27 08 21

Fiber Optic Test Instrument Data Sheet

LIGHT SOURCE			
Manufacturer:		Serial Number:	
Model:		Last Calibration:	
Spectral Width:		Coupled Power Ratio (Category):	
850-nm:		850-nm:	
1300-nm:		1300-nm:	
1310-nm:		1310-nm:	N/A
1550-nm:		1550-nm:	N/A

POWER METER			
Manufacturer:		Serial Number:	
Model:		Last Calibration:	

Note: Submit a separate data sheet for each test set being used.

Fiber Optic Reference Power Measurement Method Form

TEST SUMMARY INFORMATION

Test Personnel: _____ Date: _____

Light Source Location: _____ Power Meter Location: _____

Wavelength: _____ Reference Power Measurement (P_{ref}): _____

Method: _____

Page _____ of _____

TEST RESULTS

Strand #	Cable ID	Power (P_{sum}) (dB)	Link Seg Attn (dB)	Accep Attn (dB)	Strand #	Cable ID	Power (P_{sum}) (dB)	Link Seg Attn (dB)	Accep Attn (dB)
1					25				
2					26				
3					27				
4					28				
5					29				
6					30				
7					31				
8					32				
9					33				
10					34				
11					35				
12					36				
13					37				
14					38				
15					39				
16					40				
17					41				
18					42				
19					43				
20					44				
21					45				
22					46				
23					47				
24					48				

Fiber Optic Relative Power Measurement Method Form

TEST SUMMARY INFORMATION

Test Personnel: _____ Date: _____

Light Source Location: _____ Power Meter Location: _____

Wavelength: _____

Method: _____

Page _____ of _____

TEST RESULTS

Strand #	Cable ID	Link Seg Attn (dB)	Accep Attn (dB)	Strand #	Cable ID	Link Seg Attn (dB)	Accep Attn (dB)
1				25			
2				26			
3				27			
4				28			
5				29			
6				30			
7				31			
8				32			
9				33			
10				34			
11				35			
12				36			
13				37			
14				38			
15				39			
16				40			
17				41			
18				42			
19				43			
20				44			
21				45			
22				46			
23				47			
24				48			

SECTION 27 11 00 – COMMUNICATIONS EQUIPMENT ROOMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Buildout / fit-up of communications equipment rooms.

B. Related Divisions and Sections

1. Comply with the Related Sections paragraph of Section 270000.

2. Review Seismic Calculation requirements, specifically in Section 270000, Article 1.05.

3. Drawings, general provisions of the Agreement, and Division 01 apply to this Section.

4. Consult other Divisions, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

B. In additional to those codes, standards, etc., list in Section 270000, comply with the latest edition of the following applicable specifications and standards except as otherwise shown or specified:

1. ANSI/EIA-310-D-1992 Racks, Panels and Associated Equipment

1.3 DEFINITIONS

A. Definitions as described in Section 270000 shall apply to this section.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:

1. “UPS”: Uninterruptible Power Supply – a system that provides conditioned power with batteries acting as a continuous power source for equipment during a utility power interruption

1.4 SYSTEM DESCRIPTION

A. General: Communications rooms shall fall into one of the following space titles:

1. Intermediate Distribution Facility/Enclosure

B. Room Functions:

1. Intermediate Distribution Facility (IDF)/Enclosure will serve the following functions:

a. Houses network equipment (i.e. core switch/router, processing eqmt/servers) and voice system equipment (i.e. PBX and voice mail server)

b. House interbuilding and intrabuilding twisted pair and fiber optic backbone cabling

c. Houses network equipment (i.e. access switches) serving the horizontal cabling

d. Houses horizontal termination field – for data cabling to security devices

C. Work Covered Under Other Sections

1. Power and cooling

2. Conduit, device boxes, and sleeves

D. Base Bid Work

1. The Work under this section includes materials, accessories, fasteners, etc., and the labor and associated services required for the buildout / fit-up of telecommunications equipment rooms, and includes coordination through the General Contractor with other trades

2. In general, the Work includes the following:

a. Submittals

b. Cabinets/enclosures

c. Cable, wire and patch cord management

d. UPSs

e. Network Switches

f. Seismic bracing

g. Identification tags and labeling

h. Record Documents

i. Warranty

E. Coordination Requirements

1. Electrical: Coordinate layout with electrical contractor to ensure proper placement of lighting, sequencing of power service to rack bay, and other issues related to electrical trade.

2. Owner: Coordinate room-ready requirements and schedule with Owner (to allow Owner to plan and execute installation of OFOI telecommunications/network equipment).

1.5 SUBMITTALS

A. Comply with the Submittal requirements of Section 270000.

B. Quantity: Furnish quantities of each submittal as noted in Section 270000.

C. Submittal Requirements at Start Of Construction:

1. Product Data Submittal

2. Shop Drawings Submittal: Consisting of any proposed changes to room plans.

3. Sample Submittal: Submit sample of equipment rack label.

4. Seismic Calculations: Rack anchorage into concrete flooring with overall rack bracing, based on maximum rated load capacity.

5. Schedule Submittal: Submit proposed schedule of work (this schedule may be combined with the schedule developed for Division 27.

D. Submittal Requirements at Close Out:

1. As-Built Drawings Submittal

E. Substitutions

1. Requests for substitutions shall conform to the general requirements and procedure outlined in Section 270000.

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. Warrant Work to perform as described within this Section for a period of 1 year. Correct deficiencies within 24 hours of notification.

PART 2 - PRODUCTS

2.1 EQUIPMENT CABINET

A. Application: Suitable for the support of network equipment, IT equipment (servers, storage devices, etc.), termination apparatus, cable & cord management apparatus, common communications equipment, and other similar equipment.

B. Frame Material: Welded 12 gauge steel.

C. Assembly:

1. The frame shall be cubic in design, with a rectangular front, back, top, bottom, and sides.

2. The frame shall be welded.

3. The frame shall have the capacity for four mounting rails, minimum.

4. The frame shall come equipped with two vertical cable management sections, fully compatible with the frame.

D. Static load rating: 2,500 lbs.

E. Finish: epoxy-polyester hybrid power coat paint, black

F. Exterior (Overall) Dimensions: 82.10” high x 27.87” wide x 31.46” deep.

G. Mounting Rails:

1. 42U capacity

2. RMUs shall be marked on the mounting channel.

3. The mounting holes shall be pre-threaded as #12-24 rolled threading.

H. Manufacturer:

1. Hoffman

a. #PDCP2078BAC; “Proline” cabinet, AC ready, black, solid top, solid sides, solid front door, solid back door, 2 tapped rail pairs

b. #CR290426G002; CR mid-size air conditioner, 3500/4000 BTU, 120V

2. Or products similar in design, construction, and performance.

2.2 EQUIPMENT RACK – WALL-MOUNT TYPE

A. Application: Suitable for the support of termination apparatus, cable and cord management apparatus, network equipment, and other similar equipment, for use in an exterior location.

B. Mounting Flanges:

1. Mounting Holes: Threaded, spaced at 5/8" - 5/8" - 1/2", compatible with ANSI/EIA-310-D

2. Threading: #12-24 rolled, compatible with ANSI/EIA-310-D

3. RMU Markings: The RMU markings shall be permanently stamped on the 'user side' of both mounting flanges.

C. Finish: Light-gray powder coated

D. Manufacturer:

1. Hoffman

a. #PTDHS242429GA4; 24"H (12 RMU) x 24" x 29" deep wall-mount PROTEK Type 4 AC package cabinet

2. Or product similar in design, construction, and performance.

2.3 HORIZONTAL MANAGEMENT PANEL

A. Application: Suitable for installation into equipment rack for horizontal cord management. The horizontal management panel shall match (and fully integrate with) the vertical management sections.

B. The horizontal management panel shall be single-sided.

C. Size: 1U high by 19" mounting wide.

D. Color: black (guides and cover).

E. Manufacturer:

1. CPI

a. #30139-719; horizontal management panel, single sided, 1U, black

2. Or product similar in design, construction, and performance.

2.4 POWER STRIPS

A. Horizontal Power Strip

1. Application: Suitable for installation into equipment rack and/or cabinet for power distribution, and oriented horizontally for a 1U 19" rack mounted installation.

2. Input: 120V 20A, with a 6' (minimum) long cord. Output: 10 NEMA 5-20R outlets.

3. Switched

4. Current Rating: 20 Amps.

5. Manufacturer:

a. Geist

1) #BR100-1025; rack-mountable power strip, 20A, 10 NEMA 5-20 outlets

b. Or product similar in design, construction, and performance.

2.5 UNINTERRUPTABLE POWER SUPPLY (UPS)

A. Application: Suitable for installation within an IT room (e.g., IDF), and for a 19" rack mounted installation.

B. UPS shall have 3,000 volt-amperes (3kVA) and 1,500 volt-amperes (1.5 kVA) capacity.

C. Manufacturer:

1. APC

a. #SMX3000RMLV2U; "SmartUPS X" 3kVA UPS

b. #SMT1500RM2U; "SmartUPS" 1.5kVA UPS

2. Or product similar in design, construction, and performance.

2.6 NETWORK SWITCH

A. Application: Suitable for installation within an IT room (e.g., IDF), and for a 19" rack mounted installation.

B. Manufacturer:

1. Cisco

a. #WS-C3560X-24P-S; 24-port POE+ network switch

2. Or product similar in design, construction, and performance.

2.7 PLATES, FOR EQUIPMENT RACKS

A. Label plate shall be suitable to affix onto top angle of equipment rack or onto the top front of a frame/cabinet.

B. Label plate shall be 'engrave-able' stock melamine plastic laminate substrate.

C. Size (minimum): 1/2-inch high by 6 inches long by 1/16-inch thick.

D. Color: Black.

E. Lettering shall be white, engraved, 1/8-inch high.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Prior to installation, verify equipment rooms are suitable for the construction scope of this section. Schedule work to prevent damage caused by other trades during the course of that other construction.

B. Prepare surfaces, such as floors, for permanent installation of products, such as racks.

3.3 INSTALLATION

A. Rack Bays

1. Equipment Racks

a. Provide parts and accessories required to complete each rack. Completely assemble racks, according to manufacturer's instructions.

b. Anchoring/Bracing

1) Use concrete anchors approved by structural engineer.
2) Anchor racks to the structural floor at four points.
3) If required for seismic bracing, provide bracing devices (e.g., brackets, threaded rod with strut, etc.) attached to the wall or structure above using appropriate fasteners.

2. Vertical Management Sections

a. Provide vertical management sections as shown on Drawings. If not shown, provide a default of one vertical management section between each rack and at either end of the bay.

b. Bolt vertical management sections to the equipment racks at the points designed by the manufacturer and per the manufacturer's installation instructions.

3. Tolerances:

a. Equipment Rack: Verify dimensions to establish proper clearances as follows:
   1) Front: 40" clearance from channel's front mounting flange.
   2) Back: 57" clearance from channel's back mounting flange.

b. Provide the correct amount of space between each rack for proper installation (according to manufacturer's written instructions) of the vertical management sections.

4. Horizontal Management Panels

a. Provide horizontal management panels as shown on Drawings. If not shown, provide one management panel above each patch panel and on below the bottom patch panel in each rack bay where patch panels occur.

b. Provide fasteners and parts required to complete the installation.

5. Accessories

a. Provide rack mounting screws – 1 bag of screws per rack, as come packaged with the rack product. Attach the screws directly to the rack (visible for the punch walk). This shall constitute turn-over to the Owner.

B. Wall-Mount Equipment Racks

1. Provide parts and accessories required to complete each rack. Completely assemble racks, according to manufacturer's instructions.

2. Anchoring/Bracing

a. Install racks to the plywood backboard using lag bolts, concrete anchors, or other fasteners suitable for the purpose at all attachment points.

3. Horizontal Management Panels

a. Provide horizontal management panels as shown on Drawings.

b. Provide fasteners and parts required to complete the installation.

4. Accessories

    a. Furnish 1 bag of rack mounting screws, as come packaged with the rack product, to Owner prior to room turn over.

C. Horizontal Power Strips in IDFs/Enclosures

1. Provide horizontal power strips as shown on Drawings. If not shown, coordinate the installation height with the Owner / Owner's Representative. Provide fasteners and parts required to complete the installation.

2. Route the input cord within designated cable management and provide cord fasteners to prevent movement of the input cord. Plug the input cord into the receptacle designated by the Owner / Owner's Representative.

D. Network Switches in IDFs/Enclosures

1. Provide network switches as shown on Drawings. Install the switches according to manufacturer's instructions.

E. UPSs in IDFs/Enclosures

1. Provide UPSs as shown on Drawings. Install the 3000 kVA UPS in the Ground Level IDF/Enclosure. Install the 1500 kVA UPS in the Level 4 IDF/Enclosure. Provide fasteners and parts required to complete the installation.

3.4 LABELING

A. General Requirements: Labeling and identifier assignment shall conform to TIA/EIA-606-A Administration Standard and as approved by Owner before installation.

B. Equipment Rack Label Requirements: Provide one label plate per rack and cabinet/frame. Permanently affix label plate and position as shown on the Drawings; if not shown on the Drawings, center the label plate on the rack's front top angle or the cabinet's top front frame.

C. Identifier Assignment

1. Equipment Racks

    a. Prefix: "RACK"

    b. First field: the IDF room identity; for example: "02.S".

    c. Second field: the rack number; for example: "01".

    d. Example; "RACK 02.S-01"

2. Equipment Cabinets

    a. Prefix: "CABINET"

b. First field: the row identity; for example: “A”.

c. Second field: the cabinet number; for example: “01”.

d. Example; “CABINET A01”

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 270000.

B. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION 27 11 00

SECTION 27 13 24 – COMMUNICATIONS BACKBONE OSP FIBER OPTIC CABLING

PART 1 - GERNERAL

1.1 SUMMARY

A. Section Includes:

1. Backbone outside plant (OSP) fiber optic cabling

B. Related Sections

1. Comply with the Related Sections paragraph of Section 270000

2. 270821 Communication Fiber Optic Testing

1.2 REFERENCES

A. Comply with References requirements of Section 270000.

1.3 DEFINITIONS

A. Refer to Section 270000 for Definitions.

B. In addition to those Definitions of Section 270000, the following list of terms as used in this specification defined as follows:

1. “HDPE”: High Density Polyethylene

2. “LDPE”: Light Density Polyethylene

3. “MDPE”: Medium Density Polyethylene

4. “MM”: Multimode [fiber type]

5. “OSP”: Outside Plant [cabling]

6. “PE”: Polyethylene

7. “SM”: Singlemode [fiber type]

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections

1. Pathways: The communications pathways consist of conduits and will be covered under another Section. Refer to the Drawings for size/capacity and route information.

2. Rooms: Build out of the rooms (IDF/Enclosures) will be covered under another Section. Refer to the Drawings for build out information.

B. Base Bid Work

1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working telecommunications backbone fiber optic cabling system installation described in this Section and shown on related Drawings.

2. The Drawings are diagrammatic in nature, and require shop drawings to complete the detailed design of the telecommunications infrastructure.

3. Consider Backbone cabling, as shown on Drawings, as base bid work, unless otherwise noted, including terminations at both ends.

4. In general, the base bid work includes:

a. Submittals

b. Backbone outside plant (OSP) fiber optic cables and terminations

c. Bonding (cable armor, termination apparatus, etc)

d. Cable management

e. Crossconnections / patching.

f. Cable identification tags and system labeling

g. Record Documents

h. Warranty

1.5 SUBMITTALS

A. Comply with Submittal procedural, quantity, and format requirements of Section 270000.

B. Submittal Requirements Prior To Start Of Construction:

1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.

2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for Division 27.

3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations.

C. Submittal Requirements at Closeout:

1. Copy of the manufacturer's printed reel documentation, including the following.

a. Manufacturer's reel number

b. Manufacturer's traceable batch number

c. Length of the fiber cable on the reel

d. Maximum attenuation

e. Minimum bandwidth

2. As-Built Drawings

3. Crossconnection records/cut sheets

4. O & M Manuals

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be manufacturer certified to install the proposed and submitted cabling system and to provide an extended warranty. Provide satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid submission.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. The communications cabling system, as specified in this Section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover optical performance of cabling system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Corning Cable Systems (substitutions allowed)

B. Or manufacturer of products similar in design, construction, and performance.

2.2 SUBSTITUTIONS

A. Comply with the Substitutions requirements of Section 270000.

2.3 FIBER OPTIC CABLE –INDOOR/OUTDOOR INTER-LOCKED ARMORED, NON-PLENUM/RISER RATED

A. Application:

1. Cable shall be suitable for outdoor installations within underground pathways system and/or within innerduct/sub-ducting, and for indoor installation, between floors in vertical riser system, under access flooring, and through overhead ceiling space (in basketway, cable tray, conduit, and/or hangers).

2. Optical transmission performance shall not be significantly affected by environmental fluctuations, installation, or aging.

3. Materials shall not evolve hydrogen in quantities that will increase light attenuation.

B. Multimode 50/125 μm fiber strands shall meet or exceed the following geometry criteria:

1. Core diameter = 50 μm, ±3.0 μm.

2. Cladding diameter = 125 μm, ±1.0 μm.

3. Core/Cladding Concentricity = ≤ 3 μm.

4. Minimum Tensile Strength = 100,000 psi.

C. Multimode 50/125 μm fiber strands shall meet or exceed the following performance criteria:

1. Attenuation = 3.5 dB/km at 850 nm and 1.5 dB/km at 1300 nm wavelengths, maximum.

2. Overfilled Bandwidth = 500 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.

3. Laser Bandwidth = 2,000 MHz•km at 850 nm and 500 MHz•km at 1300 nm wavelengths, minimum.

D. Primary Coating:

1. Each fiber shall be completely covered with a “primary coating” (acrylate material).

2. Coating diameter = 250 μm, ±5 μm.

E. Buffering:

1. Each coated fiber shall be fully covered with a material extruded over and directly onto the coating. This shall be the tight buffer. Tight buffer diameter = 900 μm, ±5 μm. Material = PVC, or equivalent flame retardant thermoplastic.

2. Buffered strands shall be individually color-coded to meet the requirements of ANSI/TIA/EIA-598-A-1995. (Also, ref. ANSI/ICEA S-83-596-1994, and EIA-230)

F. Cable Sheath:

1. Strength Element: The cable shall have an internal strength element such as aramid yarn (e.g., Kevlar).

2. Inner Jacket: The cable shall have a seamless inner jacket (material = PVC, or equivalent) applied to and completely covering the internal components (fiber strands, strength element, other).

3. Armor: The cable shall have an interlocking metallic armor applied spirally and longitudinally to and completely covering the cable.

4. Outer Jacket: The cable shall have a seamless outer jacket applied to and completely covering the armor. The jacket material shall be UV resistant PVC, or equivalent.

5. Tensile Strength: The cable shall have a 300-lb, minimum, rated load.

6. Flame Rating: NEC (Article 770) rated as OFCR, and UL listed as such.

G. Manufacturer:

1. Corning Cable Systems

a. #012S8F-31180-A1; “FREEDM One” outdoor/indoor OFNR cable, 12-strand 50/125μm

2. Or product similar in design, construction, and performance.

2.4 FIBER OPTIC PATCH PANELS

A. Application:

1. Fiber optic patch panels shall be an enclosed housing for protecting, storing and organizing the termination of fiber cable(s) and fiber strands, shall provide means to strain relieve and support of the specified cables, shall contain facilities to store fiber slack, and shall provide patch cord management.

2. Fiber optic patch panels shall be passive physical equipment and apparatus used in terminating, interconnecting, and cross-connecting fiber optic cabling, shall possess a minimum fire resistant rating of UL94V-1, and shall conform to existing OSHA Health and Safety Laws.
3. Fiber optic patch panels shall be rack-mountable.

B. Fiber optic patch panels shall come equipped with safety labels such as laser identification or warning labels as required by system considerations.

C. Manufacturer:

1. Corning Cable Systems

a. #CCH-01U; “Connector Closet Housing” type patch panel, 1U, holds 2 adapter modules

b. #CCH-CP12-E4; Adapter Module e/w 6 duplex MM LC aqua adapters

2. Or product similar in design, construction, and performance.

2.5 FIBER OPTIC CONNECTORS

A. Multimode Fiber Optic Connectors – LC Type

1. Materials:

a. Ferrule: ceramic with pre-radiused finish/face

b. Connector Housing: Plastic

2. Connector shall have an integral strain relief feature, including a bend limiting rear boot.

3. Connector shall be installable via either epoxy or anaerobic method.

4. Manufacturer:

    a. Corning Cable Systems
        1) #95-051-98-SP; LC type connector, ceramic ferrule, for 50/125 μm MM, aqua boot

5. Or product similar in design, construction, and performance.

2.6 LABELS

A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

B. Labels for Cables

1. Labels shall be adhesive-backed and have a self-laminating feature

2. Labels shall fit the backbone cables listed above (i.e., shall fully wrap around the cable's jacket).

3. Printable area should be 1 inch wide x 0.5 inch high, or larger

4. Printable area color shall be white

5. Manufacturer:

    a. Panduit
        1) #S200X225YAJ; labels cables 0.24" (6.06mm) - 0.48" (12.13mm) dia.
        2) #S200X400YAJ; labels for cables 0.32" (8.09mm) - 0.95" (24.26mm) dia.
        3) #S200X650YAJ; labels for cables 0.48" (12.13mm) - 1.59" (40.43mm) dia.

    b. Or product similar in design, construction, and performance.

2.7 MISCELLANEOUS

A. Breakout Kits

1. Application: for loose buffer cables, kit to furcate coated fibers from buffer tube in preparation for "direct connectorization" type termination.

2. Manufacturer:

    a. Corning Cable Systems
        1) #FAN-BT25-06; "Buffer Tube Fan-Out Kit", for 6 fibers/tube, 25" tubing
        2) #FAN-BT25-12; "Buffer Tube Fan-Out Kit", for 12 fibers/tube, 25" tubing

    b. Or product similar in design, construction, and performance.

B. Velcro Cable Ties

1. Width: .75".

2. Color: Velcro cable ties, same color as the cable to which it is being applied.

3. Manufacturers:

a. Panduit

1) #HLS-15R-0 Black, 15' roll, cut to length

b. Or product similar in design, construction, and performance.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Pathways: Prior to installation verify that duct banks, ducts, maintenance holes, pullboxes, and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).

B. Rooms: Prior to installation, verify equipment rooms are ready for cables and terminations.

C. Prior to installation, verify cables and conductors are fully operational – both cable sheath and fiber strands. Pre-installation testing is the responsibility of the Contractor, though documentation of pre-installation testing is not a close out requirement.

3.3 INSTALLATION

A. Backbone Cable Installation and Routing

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere, unless expressly shown on the Drawings or approved in writing by the Engineer prior to installation.

2. Do not exceed 1,500 meters optical conductor length from the termination between IDFs/Enclosures.

3. Placement

a. Install cables within designated pathways.

b. Maintain a minimum bend radius of 20 times the cable diameter during installation, and a minimum bend radius of 10 times the cable diameter after installation.

c. Maintain pulling tension within manufacturer's limits. Use a pulling tension meter when using mechanical assistance during installation. Record maximum pulling tension for each cable run, and submit to the Engineer for review if requested. Replace runs when manufacturer's maximum pulling tension is exceeded.

d. Place and suspend cables in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation.

e. Only use UL approved cable-pulling compounds when necessary to reduce pulling tensions.

f. Provide 10 feet (minimum) cable slack at each end within the IDF/Enclosure; store slack in the back of the enclosures.

g. Place a pull rope along with cables where run in pathways (e.g., conduit) and spare capacity in the pathway remains. Tie off ends of the pull rope.

4. Routing

a. Neatly dress and organize cables using designated cable routing facilities, and fasten to support devices via tie wraps or Velcro-type straps.

b. Within Telecommunications Rooms, neatly dress and organize cables on designated cable support apparatus (for example, overhead cable tray or vertical cable runway), and fasten cables to cable support apparatus via tie wraps or Velcro-type straps.

5. Termination

a. Properly relieve strain from cables at termination points (at/within the fiber optic termination panels) per manufacturer's instructions.

b. Bond cable armor to grounding point (busbar) – refer to section 270526 for additional information.

c. Provide breakout kits to furcate fibers from buffer tubes.

d. Terminate/connectorize fiber strands at both ends using the specified fiber optic connectors appropriate for the mode type of the fiber. Perform terminations in accordance with manufacturer's instructions.

e. Provide required accessories and consumables for complete termination of fiber strands.

f. Provide 3 feet of unsheathed fiber (including buffer tube and broken out from the buffer tube) slack within the patch panel/termination enclosure at each end of the link. Properly store fiber slack in rear of patch panel into the 'routing rings', per manufacturer's instructions. Include 'extension' slack loop/fold in the rear of the shelf to allow for the drawer to be pulled out without putting tension on the fibers.

B. Fiber Optic Cable Termination Panel

1. Provide fully assembled termination panel in designated equipment rack; locate per Drawings (if not shown, locate at the top). "Fully assembled" includes installation and mounting components and accessories such as adapter panels, coupling adapters, etc. required for operation.

2. Provide accessories required for proper installation of each termination panel, including connector panels and adapters.

3. Bond termination apparatus to grounding point (busbar) – refer to section 270526 for additional information.

3.4 LABELING

A. General Requirements

1. Labeling, identifier assignment, and the label colors shall conform to the TIA/EIA-606-A Administration Standard and as approved by Owner or Owner's Representative before installation.

2. Provide permanent and machine generated labels; hand written labels will not be accepted.

B. Cable Labels

1. Label Format:

a. Label type shall be wrap-around self-laminating.

b. Label color shall be white background with clear laminating window.

c. Text color shall be black; text height shall be 1/8" high, minimum, or #12 font size.

2. Provide labels on both ends of cables. Fully wrap label around the cable jacket. Install labels no more than 4 inches from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

C. Termination Apparatus Labels

1. Use labels included in the product packaging. For substitutions, request approval by the Engineer.

2. Label color shall be white for respective field type, per TIA/EIA-606-A.

3. Text color shall be black, 3/32" high, minimum, or #10 font size.

D. Identifier Assignment

1. General: Separate all label fields of the identifier with a hyphen.

2. Backbone OSP Fiber Optic Cables

a. The first field shall identify the cable type: "CBF" (for Cable, Backbone, Fiber optic).

b. The second field shall identify the originating termination room identifier as shown on the plans; e.g., "MDFA.1".

c. The third field shall identify the ending termination room identifier as shown on the plans; e.g., "BDF1.1".

d. The fourth field shall identify the type and number of strands; for example, "Mxxx" where "M" stands for multimode and xxx stands for the ending fiber strand sequential count

e. Identifier Example: "CBF-MDFA.1-BDF1.1-M145-M192"

3. Termination Positions at the Termination Panels

a. Make the first field of the identifier the destination room; for example "TO IDF2.2".

b. Make the second field of the identifier the strand count range; for example, "M025-M048"

c. Identifier Example: "TO BDF1.1 M145-M192".

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 270000.

B. Remove and replace with new, at no cost to the Owner, cables or conductors failing to meet the indicated standards and not passing the testing requirements of Section 270821. The Owner, or Owner's Representative, will not accept the installation until testing has indicated a 100% availability of all cables and conductors or the Owner or Owner's Representative has approved any deviation from this requirement.

C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION 27 13 24

SECTION 27 15 13 – COMMUNICATIONS HORIZONTAL TWISTED PAIR CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Horizontal Twisted Pair Cabling (subsystem of Telecommunications Cabling Infrastructure)

B. Related Sections

1. Comply with the Related Sections requirements of Section 270000

2. 270811 Communication Twisted Pair Testing

1.2 REFERENCES

A. Comply with the References requirements of Section 270000.

1.3 DEFINITIONS

A. Refer to Section 270000 for Definitions.

B. In addition, define the following list of terms as used in this specification as follows:

1. “CAT5E”: Category 5 Enhanced [UTP] performance grade

2. “Channel”: End to end transmission path; e.g., the entire portion of the horizontal cabling to each outlet consisting of the Permanent Link, line cord (at the workstation), patch cord, and, if a full crossconnection is implemented, the crossconnect termination/connecting apparatus and equipment cord.

3. “CMP”: Communications Media Plenum [NEC plenum rating]

4. “CMR”: Communications Media Riser [NEC riser {non-plenum} rating]

5. “FEP”: Fluorinated Ethylene Propylene

6. “FTP”: Foiled Twisted Pair

7. “PE”: Polyethylene

8. “Permanent Link”: Test configuration for a horizontal cabling link excluding patch cords, equipment cords, and line cords; e.g., the ‘permanent’ portion of the horizontal cabling to each outlet consisting of cable, consolidation point (if used),

termination/connecting apparatus in the IDF/Enclosure and the connector at the outlet.

9. “PVC”: PolyVinyl Chloride

10. “UTP”: Unshielded Twisted Pair

1.4 SYSTEM DESCRIPTION

A. Work Covered Under Other Sections

1. Pathways: The communications pathways consist of conduits, and will be covered under another Section. Refer to the Drawings for size/capacity and route information.

2. Rooms: Build out of the telecommunications rooms will be covered under another Section. Refer to the Drawings for build out information.

B. Base Bid Work

1. Provide engineering, labor, materials, apparatus, tools, equipment, and transportation required to make a complete working communications Horizontal Twisted Pair Cabling System installation described in this Section and shown on related Drawings. Consider Horizontal Cabling as shown on Drawings as base bid work, unless otherwise noted. This includes terminations at both ends.

2. In general, the base bid work includes:

a. Submittals

b. Horizontal cables, terminations, and outlets

c. Cable management

d. Patch cords and crossconnections

e. Cable identification tags and system labeling

f. Record Documents

g. Warranty

1.5 SUBMITTALS

A. Comply with the Submittals article of Section 270000 for procedural, quantity, content, and format requirements.

B. Substitutions

1. Conform to substitutions requirements and procedure in Section 270000.

C. Submittal Requirements at Start Of Construction:

1. Product Data Submittal, indicating conformance with NEC, UL, TIA/EIA listings, certifications and specifications.

2. Schedule Submittal, consisting of proposed schedule of work. This schedule may be combined with the schedule developed for 27xxxx series Sections

3. Shop Drawings Submittal, consisting of proposed changes to cable routing, or termination locations/configurations

D. Submittal Requirements at Closeout:

1. As-Built Drawings

2. Crossconnection/Patching records/cut sheets

3. O & M Manuals

1.6 QUALITY ASSURANCE

A. Comply with Quality Assurance requirements of Section 270000.

B. Contractor Qualifications

1. In addition to the Contractor Qualifications requirements of Section 270000, the Contractor shall be certified by the manufacturer to provide the cabling system (proposed, submitted, and approved) and to provide an extended warranty. Submit satisfactory evidence of certification in the form of a current letter or certificate from the manufacturer as part of the bid.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with the Delivery, Storage and Handling requirements of Section 270000.

1.8 WARRANTY

A. The horizontal cabling system, as specified in this section, shall carry a 15-year (minimum) extended system warranty. This extended warranty shall cover parts and labor for the duration of the extended warranty. This extended warranty shall also cover electrical performance of cabling system to the specific category per ANSI/TIA/EIA-568-C performance criteria for horizontal cabling.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

A. Comply with the Substitutions requirements of Section 270000.

2.2 HORIZONTAL CABLE – CAT5E OSP/UNDERGROUND

A. Application: Suitable for outdoor installation, within underground pathways (conduit, pullboxes).

B. Conductors:

1. Insulated Conductors: 24 AWG solid copper, fully insulated with a thermoplastic material (material = PE, or equivalent).

2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair) with individually color-coded twisted pairs to industry standards (ANSI/ICEA Publication S-80-576-1994, and EIA-230).

C. Core & Sheath:

1. Twisted pairs shall lie individually within a polyolefin fluted center member.

2. Filled: Cable core and sheath flooded with filling compound to protect against moisture penetration.

3. Outer Jacket: seamless outer jacket (material = PE, or similar) applied to and completely cover the internal components (twisted pairs), embedded with UV inhibitors, and black in color.

D. Electrical Performance: Meet or exceed TIA/EIA-568-C.2 and ISO/IEC 11801 requirements for CAT5E UTP cabling.

E. Manufacturer:

1. CommScope Uniprise

a. #5NF4; CAT5E 4 pair UTP cable, OSP, black

2. Or product similar in design, construction, and performance.

2.3 MODULAR PATCH CORDS – CAT5E RATED

A. Application: Suitable for indoor installation within a telecommunications room or workstation environment.

B. Cords assembled from a single, continuous length of cordage, homogenous in nature, and terminated at both ends via 8 position modular plugs. Splices are not permitted anywhere.

C. Cordage

1. Insulated Conductors: 24 AWG stranded copper, fully insulated with a flame retardant thermoplastic material (such as PVC, or equivalent).

2. Twisted Pairs: Two insulated conductors “twisted” into a “pair” (twisted pair), and individually color coded.

3. Unshielded sheath and flame-retardant polyvinyl chloride (PVC) jacketed.

4. Flame Rating: NEC CM (or higher) rated, and UL listed as such.

D. Electrical Performance: Meet or exceed TIA/EIA-568-B requirements for CAT5E UTP cabling.

E. Length: Refer to Outlet Schedule for length requirements.

F. Manufacturer:

1. Commscope Uniprise

a. #UNC5-WH-3F; CAT5e modular patch cord, 3 feet, white

b. #UNC5-WH-5F; CAT5e modular patch cord, 5 feet, white

c. #UNC5-WH-7F; CAT5e modular patch cord, 7 feet, white

d. #UNC5-WH-10F; CAT5e modular patch cord, 10 feet, white

2. Or product similar in design, construction, and performance.

2.4 TERMINATION APPARATUS – MODULAR PATCH PANEL, CAT5E RATED

A. Application: Modular patch panels shall be suitable for installation within a telecommunication room (IDF or Enclosure) for the termination of the Horizontal Cables specified herein. Modular patch panels shall be horizontally oriented for a rack-mounted configuration. Modular patch panels shall be capable of supporting, organizing, labeling and patching/ crossconnecting between the horizontal termination field and the equipment termination field.

B. Modular patch panel shall have 110-type termination, and shall be compatible with the specified horizontal cables both electrically and physically.

C. Each port shall be an 8-position modular jack, compliant to TIA/EIA-568-C.2.

D. Mechanical Performance: Each port (modular jack) shall meet or exceed TIA/EIA-568-C.2 5.7.

E. Electrical Performance: Each port (modular jack) shall meet or exceed TIA/EIA-568-C.2 6.8 and ISO/IEC 11801 requirements for CAT5e UTP cabling.

F. Wiring: Modular connectors shall be T568B wired.

G. Manufacturer:

1. CommScope Uniprise

a. #UNP510-24P; CAT5E modular patch panel, flat, 24 ports

2. Or product similar in design, construction, and performance.

2.5 BEP PROTECTOR – FOR DATA CIRCUITS

A. Application: Protectors suitable for installation within a telecommunication facility for the termination of the Horizontal OSP/Underground cables intended for data circuits.

B. Protector shall be UL 497 listed.

C. Solid-state protection with clamping voltage of 16VDC.

D. Protector shall have a 4-pair capacity (minimum) with 110-type input and 110-type output

E. Manufacturer:

1. CommScope SYSTIMAX

a. #760033951; OSP protector, CAT6 rated, for PoE circuits, 2-cable capacity

2. Or product similar in design, construction, and performance.

2.6 MODULAR CONNECTOR / 8-POSITION JACK – CAT5E RATED

A. Application: Modular connectors shall be 8-position modular jacks, and shall be compatible with the specified CAT6 UTP 4-pair cables both electrically and physically.

B. Mechanical Performance: Modular connectors shall meet or exceed TIA/EIA-568-C.2 5.7.

C. Electrical Performance: Modular connectors shall meet or exceed TIA/EIA-568-C.2 6.8 and ISO/IEC 11801 requirements for CAT5e UTP cabling.

D. Wiring: Modular connectors shall be T568B wired.

E. Manufacturer:

1. CommScope Uniprise

    a. #UNJ500-WH; CAT5E modular connector/jack, white

2. Or product similar in design, construction, and performance.

2.7 WORK AREA OUTLETS

A. Surface Outlets

1. Application: Surface outlets shall be suitable for indoor installation for surface-mount device and shall be fully compatible with the specified modular connectors/jacks.

2. Color: White

3. Manufacturer:

4. CommScope SYSTIMAX
    1) #M101SMB-B-262; surface outlet box, 1 port, white
    2) #M102SMB-B-262; surface outlet box, 2 ports, white

5. Or product similar in design, construction, and performance.

2.8 LABELS

A. Labels shall be machine printable with a laser printer, ink jet printer, thermal transfer printer, or hand-held printer.

B. Labels for Horizontal Cables

1. Adhesive backed labels and self-laminating feature.

2. Fit the horizontal cables listed above (i.e., shall fully wrap around the cable's jacket).

3. Size: 2"x.05" printable area, minimum

4. Color: white

5. Manufacturer:

    a. Panduit
        1) #S100X150YAJ; labels for cable diameters 0.16"-0.32", white, desktop printer (laser or ink jet)

    b. Or product similar in design, construction, and performance.

2.9 MISCELLANEOUS COMPONENTS

A. Velcro Cable Ties

1. Width: .75".

2. Manufacturers:

a. Panduit "Tak-Ty" series cable ties

b. Panduit
1) #HLS-15R-0; black, 15' roll, cut to length.

c. Or product similar in design, construction, and performance.

PART 3 - EXECUTION

3.1 GENERAL

A. Comply with the Execution requirements of Section 270000.

3.2 EXAMINATION AND PREPARATION

A. Rooms: Prior to installation, verify equipment rooms are suitable to accept the horizontal cables and terminations.

B. Pathways: Prior to installation verify that pathways and supporting devices, provided under other sections, are properly installed, and that temporary supports, devices, etc., have been removed. Verify dimensions of pathways, including length (for example, "True Tape" the conduits).

C. Cable Integrity: Prior to installation, verify the cable's integrity – both sheath and conductors. Documentation of pre-installation testing is not a close out requirement, and is the responsibility of the Contractor.

3.3 INSTALLATION

A. Cable Installation and Routing

1. Cable runs shall have continuous sheath continuity, homogenous in nature. Splices are not permitted anywhere.

2. Place cables within designated pathways, such as cable tray, basketway, cable hangers, etc. Do no fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.

3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.

4. No cable length shall exceed 90 meters from the termination point in the IDF/Enclsoure to the termination point at the work area (permanent link).

5. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.

6. Do not exceed manufacturer's limits for pulling tension.

7. Do not use cable-pulling compounds for indoor installations.

8. Maintain a minimum bend radius of 6 times the cable diameter during and after installation.

9. Route cables under building infrastructure (such as ducts, pipes, conduits, etc); Do not route cables over building infrastructure. The installation shall result in easy accessibility to the cables in the future.

10. Place cables 6", minimum, away from power sources to reduce interference from EMI.

11. Place a pull string along with cables where run in pathways and spare capacity in the pathway remains. Tie off ends of the pull string (to prevent the string from falling into the conduit).

B. Cable Routing and Dressing within the IDF/Enclosure

1. Place cables within the overhead cable support and, when routing vertically, fasten the cables onto wall-mounted vertical cable support every 24 inches on-center using cable ties.

2. At the rack bay, route cables into the back of the vertical management sections. Divide the cables equally between both sides of an equipment rack such that a cable does not travel past the midpoint of the rack prior to termination.

3. Provide 10 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack in the rear of the enclosure.

C. Termination in the IDF/Enclosure

1. Provide termination apparatus and accessories required for a complete installation. Install and assemble termination apparatus, accessories and associated management apparatus according to the manufacturer’s instructions.

2. Properly strain relieve cables to and at termination points per manufacturer’s instructions.

3. For OSP cables, apply sealant (such as B-sealant) to the end of the cable where the pairs exit the jacket – this step to seal the end of the cable and prevent water-blocking gel from leaking of the cable's sheath.

4. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the termination apparatus. Terminate twisted pairs compliant to T568B wiring, per ANSI/TIA-568-C.0.

5. Modular Patch Panels and Horizontal Management Panels

   a. Provide quantity of modular patch panels to support termination of cables served from respective IDF/Enclosure. Provide quantity of horizontal management panels as shown on Drawings.

   b. Install and assemble modular patch panels and horizontal management panels according to the manufacturer's instructions.

   c. Install the patch panels and the horizontal management panels as shown on the Drawings.

6. Termination Sequence

   a. Terminate the cables in sequential order using the link's identifier starting at the top left and completing a panel before moving to the next panel below.

D. Termination at the Work Areas

1. Provide device components, connectors, and accessories required for a complete installation. Install and assemble connectors, jacks, adapters, termination apparatus, accessories and associated management apparatus according to the manufacturer's instructions.

2. Provide six inches, minimum, sheathed cable slack behind each workstation outlet faceplate. Coil the slack cable inside the raceway, within the wall, or in the junction box (if used), per the cabling manufacturer's installation standards.

3. Terminate cables and twisted pairs in accordance with manufacturer's latest installation requirements and ANSI/TIA-568-C.0 standard installation practices. Terminate cable pairs onto the connector compliant to T568B wiring, per ANSI/TIA-568-C.0.

E. Entrance Protector (for OSP/Underground Installation)

1. Provide protectors and accessories required for a complete installation.

2. Install the termination blocks such that the bottom row of terminations is at height shown on the Drawings. If no height is shown, install at 24" AFF on center (+/- 3").

3. Mount blocks plumb and square.

F. Perform post-installation testing as described in the Telecommunication Testing specification (refer to Section 270811). Replace terminations and connectors not passing the required media test.

G. Patching and Crossconnecting

1. In IDFs/Enclosures, provide one modular patch cord per complement/device; install between the network switch or security equipment and the horizontal field. Neatly dress patch cords within the horizontal and vertical management components. Store cord slack within the back of the enclosures.

2. Record device patching information for record documents.

3.4 LABELING

A. General Requirements

1. Labeling, identifier assignment, and label colors shall conform to ANSI/TIA/EIA-606-A Administration Standard and as approved by the Owner's Representative before installation.

2. Permanent labels with machine-generated text (hand written labels will not be accepted).

B. Label Formats

1. Horizontal Cable Labels

a. Text Attributes: Black, 1/8" high, minimum, or #12 font size.

b. Install labels on both ends of cables no more than 4" from the edge of the cable jacket. Install labels such that they are visible by a technician from a normal stance.

2. Patch Panel Labels

a. Use modular patch panel labels included in the product packaging. Request approval by the Engineer for other labels.

b. Use a label color for the respective field type, per TIA/EIA-606.

c. Text Attributes: Black, 3/32" high, minimum, or #10 font size.

3. Termination Block Labels

a. Use labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner's Representative.

b. Use a label color for the respective field type, per TIA/EIA-606-A.

c. Text Attributes: Black, 3/32” high, minimum, or #10 font size.

4. Outlet Labels

a. Use outlet labels included in the product packaging. Any deviation from this requirement must be approved in writing by the Owner’s Representative.

b. Label Background: White.

c. Text Attributes: Black, 1/8” high, minimum, or #12 font size.

d. Install label in the top label window. Leave the bottom label window blank.

C. Identifier Assignment

1. General: Separate label fields of the identifier with a hyphen.

2. Horizontal Cables

a. First field: the originating room/enclosure identifier; for example: “A2.1”.

b. Second field: the destination room number; for example: “207”.

c. Third field: the cable’s intended service type followed by a unique sequential number; for example: “V1” (voice, cable #1) or “D2” (data, cable #2).

d. Fourth field: the cable type; for example: “CAT3” or “CAT5E”.

e. Example: “A2.1–207–D2–CAT5E”

3. Outlets

a. First field: the originating room/enclosure identifier; for example: “A2.1”.

b. Second field: the destination room number; for example: “207”.

c. Third field: a unique sequential number; for example: “01”.

d. Example: “A2.1–207–01”

4. Individual Ports at the Outlets

a. First field: the cable’s intended service type followed by a unique sequential number; for example: “V1” (voice, cable #1) or “D2” (data, cable #2).

5. Individual Ports at Patch Panels

a. First field: the destination room number; for example: “207”.

b. Second field: the cable's intended service type – for example: "D" (data), and a unique sequential number – for example: "2".

c. Example: "207–D2"

3.5 FINAL INSPECTION AND CERTIFICATION

A. Punch the Work of this Section compliant to the requirements of Section 270000.

B. Remove cables and replace with new those failing to meet the indicated standards and not passing the testing requirements of Section 270811 with no impact to cost and schedule. The Owner's Representative, will not accept the installation until testing has indicated a 100% availability of all cables and conductors. Any deviation from this requirement must be approved in writing by the Owner's Representative.

C. Comply with system acceptance and certification requirements of Section 270000.

END OF SECTION 27 15 13

SECTION 28 00 00 – BASIC SECURITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes general administrative and procedural requirements for Division 28 and is intended to supplement, not supersede, the requirements specified in Division 1.

B. The requirements described herein include the following:

1. References
2. Definitions
3. System Description
4. Submittals
5. Quality Assurance
6. Product Delivery, Storage, and Handling
7. Project Management and Coordination Services
8. Warranty
9. Maintenance

C. Products furnished and installed under another section:

1. 120V power
2. Conduit and junction boxes
3. Phone and network connectivity

D. Related Sections:

1. Consult other Sections, determine the extent and character of related work, and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable installation.
2. Section 28 05 13 – Security System Cabling
3. Section 28 05 53 – Security System Labeling
4. Section 28 08 00 – Security System Acceptance Testing

5. Section 28 23 00 – Video Surveillance System

6. Section 28 26 00 – Entry Telephone System

7. Earthwork: Include trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, in-grade pull boxes, vaults, and bollard foundations. Refer to Division 2, Earthwork.

8. Selective Demolition: Nondestructive removal of materials and equipment for reuse or salvage as indicated. Also dismantling electrical materials and equipment made obsolete by these installations. Refer to Division 2, Selective Demolition.

9. Concrete Work: Include forming, steel bar reinforcing, cast-in- place concrete, finishing and grouting as required for underground conduit encasement, pedestal foundations, and curbs (also includes saw-cutting of existing slabs and grouting of conduits in saw-cut).

10. Miscellaneous Metal Work: Include fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, equipment enclosures, cameras, and similar devices. Refer to Division 5, Miscellaneous Metals.

11. Miscellaneous Lumber and Framing Work: Include wood grounds, nailers, blocking, fasteners, and anchorage for support of security materials and equipment. Refer to Division 6, Rough Carpentry.

12. Moisture Protection and Smoke Barrier Penetrations: Include membrane clamps, sheet metal flashing, counter flashing, caulking and sealant as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors, ceiling slabs and foundation walls. Tape and make vapor tight penetrations through vapor barriers at slabs on grade. Refer to Division 7, Thermal and Moisture Protection.

13. Painting: Include surface preparation, priming and finish coating as required for security cabinets, exposed conduit, pull and junction boxes, and devices where indicated as field painted in this Division. Refer to Division 9, Painting.

14. Elevators: Include interface to elevator floor and hall call on security related elevators. Refer to Division 14, Conveying Systems.

1.2 REFERENCES

A. General

1. Codes, standards, and industry manuals/guidelines listed by reference, including revisions by issuing authority, form a part of this specification section to extent indicated. Consider such codes and/or standards a part of this Specification as though fully repeated herein.

2. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.

3. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies shall mean that latest edition of such publications adopted and published prior to submittal of the bid unless otherwise specifically stated.

B. Codes: Perform Work executed under this Section in accordance with applicable requirements of the latest edition of governing codes, rules and regulations including but not limited to the following minimum standards, whether statutory or not:

1. United States Department of Labor (DOL) Regulations (Standards - 29 CFR)

   a. Part 1910, “Occupational Safety and Health Standards”

2. National Fire Protection Agency (NFPA)

   a. NFPA 70, “National Electrical Code” (NEC)

   b. NFPA 75, “Protection of Information Technology Equipment”

3. California Code of Regulations (CCR) Title 24, California Building Standards Code Part 2, Basic Building Regulations and Part 3, California Electrical Code (CEC)

4. Uniform Mechanical Code (UMC)

5. National, State, Local and other binding building and fire codes

6. FCC Regulations:

   a. Part 15 – Radio Frequency Devices & Radiation Limits

   b. Part 68 – Connection of Terminal Equipment to the Telephone Network

C. Standards: Perform Work and furnish materials and equipment under Division 28 in accordance with the latest editions of the following standards as applicable:

1. Underwriter's Laboratories (UL): Applicable listing and ratings.

   a. UL 294: Access Control System Units

   b. UL 1076: Proprietary Burglar Alarm Units and Systems

   c. UL 2044 Commercial Closed-Circuit Television Equipment

1.3 DEFINITIONS

A. The Definitions of Division 1 apply to the 28xxxx sections

B. In addition to those Definitions of Division 1, the following list of terms as used in this specification defined as follows:

1. "Owner": City of Industry

2. "Engineer": TEECOM Design Group

3. "Furnish": To purchase, procure, acquire, and deliver complete with related accessories.

4. "Install": To set in place, join, unite, fasten, link, attach, set up or otherwise connect together and test before turning over to the Owner, parts, items, or equipment supplied by contractor or others. Complete installation and make ready for regular operation.

5. "Provide": To furnish, transport, install, erect, connect, test and turn over to the Owner, complete and ready for regular operation.

6. "Connect": To install required patch cords, equipment cords, cross-connect wire, etc. to complete an electrical or optical circuit.

7. "As directed": As directed or instructed by the Owner, or their authorized representative.

8. "Cabling": A combination of cables, wire, cords, and connecting hardware (e.g., cables, conductor terminations, connectors, outlets, patch panels, blocks, and labeling).

9. "System": The access control, video surveillance, intrusion detection, and entry telephone systems

10. "SEC": Security Equipment Cabinet

11. "SJB": Security Junction Box

12. "VSS": Video Surveillance System

1.4 SYSTEM DESCRIPTION

A. Overview

1. The Owner intends to construct a parking structure at 600 S. Brea Canyon Road, City of Industry, CA. The site is currently a parking lot. The parking structure project consists of 4-5 levels with 450-600 spaces.

2. Security at the new facility will consist of an IP video surveillance system and blue light assistance phones.

3. Provide a high level of coordination services to ensure the proper installation and functioning of the security system.

4. Coordinate the installation of the security system with other trades. This may include: review of other's subcontractor's shop drawings, attendance at meetings, providing samples for mockup, and preparation & distribution of written documentation.

5. Refer to Division 1 for detail building description.

B. Base Bid Work

1. Video Surveillance System (VSS)

a. The Owner requires a video surveillance to provide real-time monitoring of the facility, a historic record of activity and activations of blue light assistance phones.

b. The VSS consists of IP cameras, power supplies, and network video recorders.

c. Refer to Section 28 23 00 for detailed description of system.

2. Security Communications System

a. The Owner requires blue-light assistance phones in the parking garage.

b. Refer to Section 28 26 00 for detail description of system.

3. The System includes integration with the Elevator conveying system to provide the following:

a. Analog video surveillance within the elevator cab

1.5 SUBMITTALS

A. Submit required submittals to the General Contractor in the quantities and formats as required under the general contract. In the absence of requirements, provide as described in the following with reference to quantity and format.

B. Contractor Qualifications

1. Resumes of the Project Manager, General Foreman, and Lead Technician(s) indicating role, years of experience, product certifications and training, listing of similar projects the individual performed the role proposed for this project along with client contact information for each.

2. Certification letters stating the Contractor is an authorized reseller, installer, and extended warranty provider for the following systems:

a. VSS manufacturer & certification level

C. Product Data

1. Obtain written approval from the Engineer for the product data submittal prior to the release of materials and equipment purchase order and prior to installation.

2. Quantity: Submit product data submittals as described in Division 1.

3. Format:

a. Minimum Format: Submit each product data submittal in an 8-1/2 x 11 inch folder. Product data submittal shall be in a 3-ring binder (or similar). If in a 3-ring binder, insert the submittal information the transparent front cover and spine pockets.

b. Clearly label the cover and spine of each submittal with the following information:
   1) Client Name
   2) Project Name and Address
   3) Project Submittal Number
   4) Submittal Name (e.g., “Product Data Submittal for Video Surveillance System”)
   5) Specification Section Number (e.g., “Section 28 23 00”)
   6) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2010”)
   7) Contractor Name

c. Include a Table of Contents at the beginning of the submittal that lists materials by article and paragraph number (e.g., “2.02-A Network Video Recorders”).

d. Include tabbed separators for improved navigation through the submittal.

4. Content:

a. Cover Letter: Product data submittals shall include a cover letter stating that the submittal is in full compliance with the requirements of the Contract Documents. Sign (and stamped, if applicable) cover letter and list items and data submitted. Have the person who prepared the submittal sign the document as well. Failure to comply with this requirement shall constitute grounds for rejection of submittal.

b. Product Information: Product Data submittal shall consist of manufacturer's technical data, product literature, "catalog cuts", data sheets, specifications, and block wiring diagrams (if necessary). This data shall clearly describe the product’s characteristics, physical and dimensional information, electrical performance data, materials used in fabrication, material color & finish, and other relevant information such as test data, typical usage examples, independent test agency information, and storage requirements. Clearly indicate by arrows or brackets precisely what is being submitted on and those optional accessories, which are included and

those which are excluded. At a minimum, include products listed in the Division 28 specifications. Include relevant products that will be installed, which are not listed in the specifications.

c. Re-submittals: Provide a cover letter with the re-submittal that lists the action taken and revisions made to each product submittal in response to Submittal Review Comments. No review shall take place for any re-submittal packages that is not accompanied by this cover letter. Failure to include this cover letter will constitute rejection of the re-submittal package.

D. Shop Drawings

1. Obtain written approval from the Engineer for the shop-drawings submittal prior to the release of materials and equipment purchase order and prior to installation.

2. Quantity and Media: Submit shop-drawings as described in Division 1.

3. Format:

a. Produce shop drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

b. Use the same size drawing sheet as the drawings of the Contract Documents.

c. Text: minimum of 3/32” high when plotted at full size.

d. Screen background information.

e. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

f. Scaling:
   1) Scale floor plans at 1/8”=1’-0”
   2) Scale enlarged room plans at 1/4”=1’-0”
   3) Scale wall elevations at 1”=1’-0”

4. Content:

a. Submit shop drawings that represent proposed installation of security system.

b. Floor Plans: Scale floor plans at 1/8”=1’-0”. Floor plans shall show:
   1) Locations and identifiers of security devices.
   2) Size, quantity, location and proposed routes of security cabling.
   3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).

c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.

d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.

e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

f. Proposed mounting details

E. As-Built Drawings

1. Quantity and Media: Submit as-built drawings as described in Division 1.

2. Format:

a. Produce as-built drawings using AutoCAD, or other computer design application that can save files to AutoCAD-compatible files.

b. Use the sheet size as the drawings of the Contract Documents, and use the project title block.

c. Text: minimum of 3/32” high when plotted at full size.

d. Use symbols identical to the symbols shown on the Drawings.

e. Screen background information.

f. Plot system components (devices, cable routes, etc.) and text at a sufficient line weight to stand out against background information.

3. Content:

a. Submit as-built drawings that fully represent actual installed conditions and that incorporate modifications made during the course of construction.

b. Floor Plans: Scale floor plans at 1/8”=1’-0”. Floor plans shall show:
   1) Locations and identifiers of security devices.
   2) Size, quantity, location and proposed routes of security cabling.
   3) Size, quantity, location, and routes of pathways (such as cable trays, cable basket, conduits, cable hangers, and other cable support devices).

c. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices.

d. Schedules: Provide schedules for devices and control panels that show each point ID with a description of the connected devices.

e. Block Diagram/Riser Diagram: Show the devices, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

f. Custom mounting details

F. Operation and Maintenance (O&M) Manuals

1. Quantity: Submit quantity of O&M Manuals as described in Division 1.

2. Format:

a. Submit each O & M Manual in a white, 3-ring binder with front cover and spine clear pockets for insertion of the project information.

b. Clearly label the cover of each O&M Manual with the following information:
1) Client Name
2) Project Name and Address
3) Manual Name (e.g., “Operation and Maintenance Manual for Telecommunications Cabling System”)
4) Date of Submittal Format: <month> <day>, <year> (e.g., “January 1, 2010”)
5) Contractor Name

c. Include a Table of Contents at the beginning that lists the contents.

d. Include tabbed separators for improved navigation through the manual.

3. Content:

a. 11”x17” prints of as-built drawings, as described above

b. Manufacturer's original catalog information sheets for each component provided under applicable Section (typically, this is similar to the accepted product data submittal)

c. Warranty certificate from the manufacturer and the Contractor

d. Manufacturer’s instructions for system or component use

e. Instructions and requirements for maintenance and warranty issues

4. Contents shall include requirements and methods for maintaining installed products.

1.6 QUALITY ASSURANCE

A. Contractor Qualifications

1. A current, active, and valid and C7 or C10 California State Contractors License

2. Minimum five years experience in installation and service of access control, video surveillance, and intrusion detection systems.

3. Minimum five completed projects similar to scope and cost.

4. Evidence of technicians qualified for the work in the form of current manufacturer's training certification

B. Materials

1. Materials, support hardware, equipment, parts comprising units, etc., shall be new, unused, without defects and of current manufacturer, materials

2. Use specified products and applications, unless otherwise submitted and approved in writing.

C. Regulatory Requirements

1. Work and materials shall conform to the latest rules of National Board of Fire Underwriters wherever such standards have been established and shall conform to the regulations of the State Fire Marshal, OSHA and the codes of the governing local municipalities. Work under Division 28 shall confirm to the most stringent of the applicable codes.

2. Provide the quality identified within these Specifications and Drawings when codes, standards, regulations, etc. allow Work of lesser quality or extent. The Contract Documents address the minimum requirements for construction.

D. Drawings

1. Follow the general layout shown on the Drawings except where other Work may conflict with the Drawings.

2. Drawings for the Work within this Division are essentially diagrammatic within the constraints of the symbology applied.

3. The Drawings do not fully represent the entire installation for the security system. Drawings indicate the general route for the cables and the location of outlets. The Drawings might not expressly show every conduit, sleeve, hanger, etc., but a complete system is required.

1.7 PROJECT MANAGEMENT AND COORDINATION SERVICES

A. Project Management and Coordination Services

1. Provide a project manager for the duration of the project to coordinate this Work with other trades. Coordination services, procedures and documentation responsibility include, but are not limited to, the items listed in this section.

2. Review of Shop Drawings Prepared by Other Subcontractors:

a. Obtain copies of shop drawings for equipment provided by others that require telecommunication service connections or interface with Work.

b. Perform a thorough review of the shop drawings to confirm compliance with the service requirements contained in the Division 28 contract documents. Document discrepancies or deviations as follows:
   1) Prepare memo summarizing the discrepancy
   2) Submit a copy of the specific shop drawing, indicating via cloud, the discrepancy

c. Prepare and maintain a shop drawing review log indicating the following information:
   1) Shop drawing number and brief description of the system/material
   2) Date of the review
   3) Name of the individual performing the review
   4) Indication if follow-up coordination is required

B. Role of the Engineer

1. During the construction phase of the project, the Engineer will work with the Contractor to provide interpretation and clarification of project contract documents, reply to (and 'process') relevant Requests for Information (RFIs), and act as an interface between the Contractor and the Owner.

2. The Owner has retained the Engineer's services to observe the Work for general compliance with the Contract Documents and to ensure that the installation meets the design intent of the system.

3. In general, the Engineer will participate during the construction phase as follows:

   a. Review product data and shop drawings submittals for general compliance with the contract drawings and specifications.

   b. Review changes as they arise, and confirm that the proposed solutions maintain the intended functionality of the system.

   c. Interpret field problems for Owner, and translate between Owner and Construction Team.

   d. Review the testing procedures to confirm compliance with industry-accepted practices.

C. Use of CAD Files

1. Should the Contractor need the Engineer's CAD files to produce shop drawings and/or as-built drawings, the Engineer requires the Contractor sign a CAD files release agreement.

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Delivery

1. Do not deliver security system components to the site until protected storage space is available. Storage outdoors covered by rainproof material is not acceptable.

2. Replace equipment damaged during shipping and return to manufacturer at no cost to the Owner.

B. Storage

1. Store materials in a clean, dry, ventilated space free from temperature extremes.

2. Maintain factory wrapping or provide a heavy canvas/plastic cover to protect units from dirt, water, construction debris, and traffic.

3. Provide heat where required to prevent condensation or temperature related damage.

C. Handling

1. Handle in accordance with manufacturer's written instructions.

2. Prevent internal component damage, breakage, denting and scoring. Do not install damaged equipment. Replace damaged equipment and return equipment to manufacturer.

1.9 WARRANTY

A. Provide the Security System as described in this specification with a one-year parts and service warranty at no additional cost to the Owner.

B. Include in the warranty package, at a minimum, the following:

1. Software support agreement for the VSS

2. Software upgrades and patches

3. Labor to install software upgrades and patches necessary to maintain the latest version

4. Emergency service on regular working hour basis

5. Service by factory trained and employed service representatives of system manufacturer

C. Maintain regular service facilities and provide a qualified technician familiar with this work at the site within four (4) hours of receipt of a notice of malfunction including weekends and holidays. Provide material, devices equipment and personnel

necessary for repairs. Install approved temporary, alternate equipment if required by the Owner, complete and operational within twenty four (24) hours after notification of a malfunction, at no additional cost.

D. Conduct warranty repairs and service at the job site unless in violation of manufacturer's warranty; in the latter event, provide substitute systems, equipment and/or devices, acceptable to the Owner, for the duration of such off-site repairs. Transport warranty substitute and/or test systems, equipment, devices, material, parts and personnel to and from the job site at no additional cost.

1.10 MAINTENANCE

A. Extra Materials

1. Deliver extra materials to a secured location determined by the Owner.

2. Provide a complete Bill of Materials listing quantities, part numbers, and descriptions for each device for the Owner to sign indicating receipt of equipment.

3. Provide new and unused spare parts in their original packing materials upon delivery.

B. Maintenance Service

1. For the first year of service, conduct quarterly system performance review meetings to review system operation problems and/or defects that occurred during the preceding 3 months. During these performance review meetings, perform the following:

   a. Visual checks and operational tests of the central processor, local processors, monitors, keyboards, system printers, peripheral equipment, power supplies, and electrical and mechanical controls

   b. Clean system equipment, including interior and exterior surfaces

   c. Perform diagnostics on equipment

   d. Check and calibrate each device

   e. Run system software and correct diagnosed problems

   f. Resolve previous outstanding problems

2. Provide software and firmware updates issued free of charge by the manufacturer.

PART 2 - PRODUCTS

2.1 GENERAL

A. Material and equipment specified herein have been selected as the basis of acceptable quality and performance and have been coordinated to function as components of the included systems. Where a particular material, device, equipment or system is specified directly, the current manufacturer's specification for same is a part of these specifications, as if completely elaborated herein.

B. Use standard, regularly manufactured, materials and equipment for this and/or other similar systems, and not custom designed especially for this project. Provide systems and components thoroughly tested and proven in actual use. Provide subsystems of one manufacturer.

2.2 EQUIPMENT ENCLOSURES

A. Manufacturer: Hoffman, or equivalent.

B. General: Provide cabinets with:

1. Hinged and lockable door containing a lock kit (keyed alike with other security enclosures on the project)

2. Panduit “F” type slotted duct for routing of individual conductors

3. One tamper switch for each enclosure

C. SECs

1. Refer to shop drawing for locations and sizes.

2. Type: NEMA type 1 enclosure for interior mounted SEC’s

3. Type: NEMA type 3 enclosures for exterior mounted SEC’s

4. Size: 16” x 16” x 6” minimum, refer to drawing for exact box sizes

5. Accessories:

   a. Back panel for mounting of the relays, and terminal strips

   b. One 5” electric muffin fan for each enclosure housing electrically powered devices.
      1) One exterior screen for each fan

6. Manufacturer:

   a. Hoffman

b. SquareD

c. Or product similar in design, construction, and performance

2.3 TAMPER RESISTANT HARDWARE

A. Provide pinned-allen type hardware for exposed hardware in public spaces.

B. Provide hardware used in specialty metal surfaces that posses a similar finish color.

2.4 SUBSTITUTIONS

A. Conform to the general requirements and procedure outlined in Division 1 in the Request for Substitution.

B. Only one substitution allowed for each product specified.

C. Where products are noted as "or equal", a product of equivalent design, construction, and performance will be considered. Submit product data – catalog cuts, product information, and pertinent test data –required to substantiate that the product is in fact equivalent to that specified. The burden of proof rest with the Contractor that the substituted product is equivalent to the specified product.

D. Manufacturers' names and model numbers used in conjunction with materials, processes or equipment included in the Contract Documents are used to establish standards of quality, utility and appearance. Materials, processes or equipment that, in the opinion of the Engineer, are equivalent in quality, utility and appearance will be approved as substitutions to that specified when “or equal” follows the manufacturers' names or model number(s).

E. When the Engineer accepts a substitution in writing, it is with the understanding that the Contractor guarantees the substituted product, component, article, or material to be equivalent to the one specified and dimensioned to fit within the construction according to contract documents. Do not provide substituted material, processes, or equipment without written authorization from the Engineer. Assumptions on the acceptability of a proposed substitution, prior to acceptance by the Engineer, are at the sole risk of the Contractor.

F. Approved substitutions shall not relieve the Contractor of responsibilities for the proper execution of the Work, or from provisions of the Specifications.

G. Pay expenses, without additional charge to the Owner, in connection with substitution materials, processes and equipment, including the effect of substitution on self, subcontractor's or other Contractor's work.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Conditions: Verify existing conditions, which have been previously provided under other sections, are acceptable for product installation in accordance with manufacturer's instructions.

B. Pathways: Verify that pathways and supporting devices, which have been previously provided under other sections, are properly installed, and that temporary supports and devices have been removed.

C. Field Measurements: Verify dimensions of pathways, including length of pathways. For example, “True Tape” the conduits to verify cable distances.

3.2 FIELD QUALITY CONTROL

A. Staffing: Provide a qualified foreman who is in charge of the Work and who is present at the job site at times Work is being performed. Perform the Work using skilled technicians under the direction of the foreman. Supervise the work force executing the Work. Perform the installation within the restraints of the construction schedule. Do not change the supervisor during the project without prior written approval from the Owner.

B. Inspection: Perform inspection after installation. Keep areas of work accessible and notify code authorities, or designated inspectors, of work completion released for inspection. Document completion, and inspection as required.

3.3 INSTALLATION

A. Perform this work in accordance with acknowledged industry and professional standards and practices and the procedures specified herein.

B. Provide a complete, operating system. Include devices specified including basic components and accessories, interconnecting wiring and other equipment and installation devices necessary for a complete system as specified.

C. Manufacturer's Instructions:

1. Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.

2. Maintain jobsite file of Material Safety Data Sheets (MSDS) for each product delivered to jobsite.

D. Boxes, Panels, and Enclosures

1. Install boxes, panels, and enclosures square and plumb.

2. Set "flush mounted" units with the face of the cover, bezel or escutcheon in the same plane as the surrounding finished surface.

3. Mount boxes, panels and trim so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.

4. Install insulating terminations in signal circuit boxes, panels, wireways or enclosures.

E. Painting

1. Custom paint devices as indicated on the drawings.

3.4 REPAIR/RESTORATION

A. Replace or repair work completed by others that you deface or destroy, at not cost to the Owner.

B. Punch List:

1. Inspect installed work in conjunction with the General Contractor and develop a punch list for items needing correction.

2. Provide punch list to Engineer for review prior to performing punch walk with the Engineer.

C. Re-Installation:

1. Make changes to the system such that defects in workmanship are correct and cables and the associated termination hardware passes the minimum test requirements.

2. Repair defects prior to system acceptance.

D. Painting: Repaint surfaces altered during installation of the security system to match previous conditions.

3.5 CLEANING

A. Remove temporary coverings and protection of adjacent work areas. Remove unused products, debris, spills, or other excess materials. Remove installation equipment.

B. Leave finished work and adjacent surfaces in neat, clean condition with no evidence of damage.

C. Repair or replace damaged installed products.

D. Legally dispose of debris.

E. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.

END OF SECTION 28 00 00

SECTION 28 05 13 – SECURITY SYSTEM CABLING

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:

1. Wire and cable

2. Compression Seal BNC Connectors

C. Related Sections:

1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.

3. Section 28 05 53 – Security System Labeling: includes label types and formats.

4. Section 27 15 13 – Communications Horizontal UTP Cabling: includes cabling for IP cameras and IP blue light assistance phones.

5. Section 26 05 33 – Conduit: includes pathway types in different areas of the project.

1.2 SUBMITTALS

A. Product Data: Submit product information, including:

1. Cable Description and Use

2. Jacket Rating

3. Outside Diameter (of the overall wire or cable)

4. Manufacturer and Part Number

PART 2 - PRODUCTS

2.1 WIRE AND CABLE

A. General

1. Provide required wire and cable sized to allow for voltage drop on long runs and effectively shielded as required to allow the routing of 12 & 24V power and video signal cable in the same conduit without interference or signal noise.

2. Cable installed outdoors or in underground conduit must contain a PVC or Polyethylene jacket to prevent water intrusion and compliant with the TIA-455-82B water infiltration test.

B. Manufacturers:

1. West Penn or product similar in design, construction, and performance

2. Uniprise or product similar in design, construction, and performance

C. Video Surveillance System – IP Camera Cabling CAT5E Outside Plant (OSP) rated

1. Refer to Section 271513 for Category 5E cabling requirements for IP Cameras.

D. Video Surveillance System – Analog Elevator Camera Cabling

1. Provide minimum RG-59/U CCTV video coaxial cable between the camera and the monitoring equipment, with the following features:

a. 95% percent copper braid

b. Foam dielectric

c. Solid copper core

d. 75 ohm characteristic impedance

e. Plenum jacket

2. Plenum Jacketed Cable

a. #RG-59/U coaxial: West Penn #25815, analog camera video cable

b. #18/2 AWG unshielded: West Penn #25224B, power cable

E. Blue Light Assistance Phone Cabling

1. Plenum Jacketed Cable

a. #18/2 AWG unshielded: West Penn #25224B, power cable for Blue Light Strobe

b. Refer to Section 271513 for Category 5E cabling requirements for Blue Light Assistance Phones.

2.2 MISCELLANEOUS COMPONENTS

A. Cable Ties

1. General

a. Provide Velcro-style cable ties on security cabling within security spaces and covered wireways.

b. Dress and bind cabling with cable ties every 24” minimum.

c. Width: 0.75 inches

d. Color: Black

2. Manufacturer:

a. Panduit #HLS-15-R-0 Black, 15 feet roll, cut to length

b. Or product similar in design, construction, and performance

PART 3 - EXECUTION

3.1 INSTALLATION

A. Label cables in accordance with Section 280553 – Security System Labeling.

B. Horizontal Cable Installation and Routing

1. Provide wire and cable with a continuous, splice-free sheath for the entire length of run between designated connections or terminations. Splices not permitted.

2. Place cables within designated pathways, such as conduit. Do no fasten (such as with cable ties) or attach cables to other building infrastructure (such as ducts, pipes, conduits, etc), other systems (such as ceiling support wires, wall studs, etc), or to the outside of conduits, cable trays, or other non-approved pathway systems.

3. Place and suspend cables and conductors during installation and termination in a manner to protect them from physical interference or damage. Place cables with no kinks, twists, or impact damage to the sheath. Replace cables damaged during installation or termination at no additional cost.

4. Route cables at 90-degree angles, allowing for bending radius, along corridors for ease of access.

5. Do not exceed manufacturer's limits for pulling tension.

6. Do not use cable-pulling compounds for indoor installations.

7. Dress and secure coaxial cables to preclude stress and/or deformation.

8. Install shielded wiring or route in separate raceways as recommended by the manufacturer's current requirements.

9. Place cables 6", minimum, away from power sources to reduce interference from EMI.

10. Do not run signal wire and cable in parallel to power (120VAC).

11. Make connections to screw-type barrier blocks with insulated crimp-type spade lugs. Size lugs properly to assure high electrical integrity, i.e., low resistance connections.

12. Follow manufacturers recommended guidelines for installation.

13. When exiting the primary pathway (such as basketway or cable tray) to the work area, exit via the top of the pathway. Secure the cables to the pathway using an approved cable tie.

C. Cable Routing and Dressing

1. Homerun all field device conduits to designated Security Enclosure. Stub field device conduits into wall mounted gutter.

2. Only use Velcro type cable ties within the Electrical Room.

3. Dress and bind cabling with cable ties every 12” minimum.

4. Provide 4 feet, minimum, sheathed cable slack – length not to exceed permanent link maximum length requirement. Place the slack within the screw cover gutter wireways.

3.2 CABLE SUPPORT

A. Vertical Support

1. Riser Systems

a. Route cable through conduit in vertical riser systems.

b. Terminate conduit at each stacked closet in a lockable junction box. Refer to Section 28 00 00 – Basic Security Requirements for minimum sizing of junction boxes and equipment enclosures.

c. Fastened entire cable group to the inside of junction box at every other floor or approximately every 24 feet.

d. Fasten cable in Junction box utilizing cable ties equipped with eyelets designed to accept screws for fastening or approved equivalent method.

2. Vertical cable on floor space not in riser system

a. Route cable from below suspended ceiling devices to above ceiling when possible.
   1) Provide conduit and firestoppping for cable routed in fire rated wall assemblies.
   2) Provide conduit for cable routed from below ceiling devices to above ceiling on concrete tilt up style walls.

b. Cable routed vertically from devices with no suspended ceiling.
   1) Provide conduit stub from device junction box to 14 feet above finished floor minimum.

END OF SECTION 28 05 13

SECTION 28 05 53 – SECURITY SYSTEM LABELING

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working security system installation, as described in these specifications.

B. Section Includes:

1. Labeling of wire, cable, security devices, enclosures, and raceways.

C. Related Sections:

1. Consult other Sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.

2. Section 28 00 00 – Basic Security Requirements: includes general project requirements, submittal formats, warranty, and installation requirements.

1.2 SUBMITTALS

A. Product Data: Submit the following:

1. Product information for components specified herein.

2. List of equipment (wire, cable, devices, enclosures, and raceways) and the corresponding text for the label.

PART 2 - PRODUCTS

2.1 NAMEPLATES

A. Engraved, plastic laminated nameplates, signs, and instruction plates. Engrave stock melamine plastic laminate 1/16 inch minimum thickness for signs up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger sizes. Use white letters for engraved nameplates and punch for mechanical fasteners.

2.2 LABELS

A. Wire and Cable Labels:

1. General

    a. Self-laminating adhesive laser labels.

    b. Machine printable with a laser printer.

    c. Cable size: 0.16 – 0.32” OD

    d. Color: white with black lettering

2. Manufacturer:

    a. Brady #WML–211-295 and #WML-311-292 wire marking labels

    b. Or product similar in design, construction, and performance

B. Device Labels:

1. Self-laminating, type on tape, adhesive labels. Use Helvetica 12 pt text

PART 3 - EXECUTION

3.1 INSTALLATION

A. General Requirements

1. Label the security system components. The components include, but are not limited to, the following:

    a. Equipment Enclosures

    b. Conduits

    c. Security Devices

    d. Batteries

    e. Wires and Cables

    f. Equipment Racks

    g. Terminal Blocks

    h. Relays

    i. Patch panels, and the termination positions within the patch panels.

2. Labels to coincide with device IDs used on the record drawings.

3. Degrease and clean surfaces to receive nameplates and labels

4. Install nameplates parallel to equipment lines. Secure nameplates to equipment fronts using machine screws.

B. Equipment Cabinets

1. Label SEC enclosures associated with the security system with a nameplate.

2. Mount label on exterior of door, centered horizontally, and positioned one-third of the door height vertically from the top.

3. Example: Line 1: “SEC-01” (1/2 inch high letters)
Line 2: “Security Equipment Cabinet” (1/4 inch high letters)

C. Conduits

1. Write the destination for every conduit entering a junction box, SEC, and CEC enclosure, or wireway using a black permanent ink marker next to the conduit inside the box.

2. Example: “To SEC-01”

D. Security Devices

1. Label devices associated with the security system with a permanent machine generated, laminated, label. Use 12 point Helvetica text with a clear background. Use white or black lettering depending upon the color of the device.

2. Label each device in a concealed location with the system point number and address.

E. Batteries

1. Label power supply batteries with the month and year they were installed.

2. Example: “April 2012”

F. Wire and Cable

1. Identify wire and cable clearly with permanent machine-generated labels wrapped about the full circumference within one (1) inch of each connection.

2. Indicate the cable ID designated on the associated field or shop drawings or run sheet, as applies.

3. Assign wire or cable designations consistently throughout a given system; i.e., each wire or cable to carry the same labeled designation over its entire run, regardless of intermediate terminations.

4. Provide labels where wire and cable first enter and exit from conduit, junction or distribution boxes; locate labels within six (6) inches of the point of exit.

5. Positional labels so they are clearly visible without the need to remove wire management or other obstructions.

6. Label cables at both ends of a run and within pull and junction boxes using machine generated wrap-around labels.

3.2 CABLE LABEL FORMAT

A. From Panel to Field Device

1. Line 1: Device Type and Device Number

2. Line 2: Panel ID – Port Number

3. Example: PANEL 2 – CR5

4. Standard Device Types

   a. K = Camera

   b. R = Relay Output

5. Standard Port #s

   a. M = Monitored Input

   b. R = Relay Output

B. Communications Cable

1. Line 1: Communication Type and Direction

2. Line 2: Panel ID

3. Example: RS-485 TO
   PANEL 2

4. Typical Communication Types

   a. RS-485

   b. RS-232

   c. RS-422

END OF SECTION 28 05 53

SECTION 28 08 00 – SECURITY SYSTEM ACCEPTANCE TESTING

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, and transportation required to thoroughly test the completed security system installation as described in these specifications.

B. Base Bid Work

1. Full testing of a completed security system which includes:

a. Develop, submit, and obtain Engineer's approval of security system Pre-functional and Functional testing forms.

b. Complete 100% Pre-functional test of the security system. Submit Pre-functional testing documentation reflecting that all security devices, cabling, power, interfaces to other systems, IT switches, NVRs/servers and other components required for a completely functional security system are provided per project documents.

c. Complete 100% Functional test of the security system. Submit Functional testing documentation reflecting that all security equipment, components, interfaces, and programming are functioning correctly per project documents. Upon receiving approval of functional testing documentation, schedule final acceptance testing activities to be witnessed by Engineer and/or Owner.

d. Demonstrate 100% security system functionality to the Engineer and/or Owner. Document testing activities and submit with final As-Built drawing.

C. Related Sections:

1. Section 28 00 00 - Basic Security Requirements

2. Section 28 05 13 – Security System Cabling

3. Section 28 05 53 – Security System Labeling

4. Section 28 23 00 – Video Surveillance System

5. Section 28 26 00 – Security Communications

1.2 SUMMARY OF SYSTEM COMMISSIONING ACTIVITIES

A. Overview

1. The purpose of system commissioning is to ensure the security system operates properly when it is needed most. Security systems are very complex from both an equipment and programming standpoint, and thorough testing is necessary to ensure correct operation.

2. Perform testing activities after-hours or on weekends when the system is “quiet” and the building is generally unoccupied. This will minimize the amount of irrelevant activity in the system activity reports that will be used as a record of the pre and final test results.

B. Pre-Functional Test

1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system’s operation to the Owner and Engineer.

2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

C. Functional Test

1. Perform a 100% pre-functional test of system aspects to verify correct operation prior to scheduling the final test. The pre-test will help to make the final test run smoothly when demonstrating the system’s operation to the Owner and Engineer.

2. Document the results of the pre-test using the approved test forms and submit a copy to the Engineer along with the system activity reports

D. Final Acceptance Test

1. Perform a final test of the system in the presence of the Engineer and/or Owner to demonstrate correct operation of the security system.

1.3 SUBMITTALS

A. Operation and Maintenance Manuals: Submit the following for review and comment at the completion of the project:

1. Functional Design Manual: Includes a detailed explanation of the operation of the system.

2. Hardware Manual which includes:

a. Pictorial parts list and part numbers

b. Pictorial and schematic electrical drawings of wiring systems, including devices, control panels, instrumentation and annunciators

c. Telephone numbers for the authorized parts and service distributors

d. Include service bulletins

3. Software Manual which includes:

a. Use of system and applications software

b. Initialization, start-up, and shut down procedures

4. Operator's Manual which fully explains procedures and instructions for the operation of the system and includes:

a. NVR/Computers and peripherals

b. System start up and shut down procedures

c. Use of system, command, and applications software

d. Recovery and restart procedures

e. System access requirements

5. Maintenance Manual which includes:

a. Instructions for routine maintenance listed for each component, and a multi-page summary of component's routine maintenance requirements.

b. Detailed instructions for repair of the security system.

c. A summary of the software licenses, including license numbers, quantity of clients, summary of the software options provided and database capabilities.

d. A summary of the TCP/IP address used and which system component they are associated with. Include the gateway address, subnet mask, DNS server, and host name information.

6. Test Results Manual, which includes the document results of tests, required under this Specification, organized by System, Floor, and Door.

7. Record Drawings Manual which includes 11"x17" prints of record drawings as described below.

B. Record Drawings: Submit the following for review and comment at the completion of the project:

1. Drawings to fully represent installed conditions including actual locations of devices, actual cable and terminal block numbering, and correct wire sizing as

well as routing. Record changes in the work during the course of construction on blue or black line prints.

2. Include drawings submitted as part of the Shop Drawing package, plus additional information required to accurately document installed conditions.

3. Include the following additional information:

   a. Device addresses & IP address information.

   b. Settings for each camera

4. Final acceptance will not be made until the Engineer approves the record drawings.

1.4 QUALITY ASSURANCE

A. Provide a project manager to coordinate the security system commissioning work with other trades.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 SCHEDULING

A. Coordinate security commissioning with the General Contractor, and provide specific information on pre-test and final-testing activities to be entered into the overall project construction schedule.

3.2 TESTING REQUIREMENTS

A. Site Tests

1. Perform a 100% pretest of the system prior to final testing by the Engineer. Provide the Engineer with a minimum of a 5 day notice prior to scheduling testing.

2. At the conclusion of the work on a floor, test the system on that floor to verify proper operation and reporting of devices.

3. Work with the door hardware supplier to resolve electric hardware failures and door alignment/closure problems.

4. At the completion of the work, test the entire system to verify proper operation. At a minimum, include these tests:

   a. Building Perimeter Test: Test cameras and devices related to securing the perimeter of the building.

   b. Electrical Room Test: Test equipment located in the Electrical Room. Inspect system panels, power supplies, and other related security equipment located in these areas.

   c. CCTV Recording System Test: Test the recording system for correct programming, alarm recording, and event retrieval. Verify correct integration with the Blue Light Assistance Phones. Test and verify CCTV system viewable from workstations.

   d. CCTV Camera Test: Review cameras for proper coverage, quality of video, etc.

   e. Assistance Phone Test: Test phone stations for proper communication, primary phone numbers, backup phone numbers, and alarm call-up.

   f. Battery and UPS Load Test: Disconnect AC power to security system equipment to verify battery operation functions and system remains fully operational.

B. Test Preparation

1. Provide device identification numbers that differ from or were not included on the original contract drawing set.

2. Provide a complete systems point list.

3. During testing, provide a minimum of three technicians familiar with the installation to assist with the test. Stage the technicians as follows: one at the host, one at the device being tested, and one runner responsible to furnishing tools, step ladders, etc.

4. Provide radios for use by the Engineer and Owner during testing.

3.3 TEST PROCEDURES

A. Refer to the test forms for testing procedures for each type of device/system.

3.4 DOCUMENTATION

A. Provide a full-sized blueline drawing containing a detailed wiring diagram (layout of equipment/elevation, complete parts list, and a complete wiring diagram for each camera for each SEC. Fold the diagram and place it inside a clear plastic pocket affixed to the inside door of the SEC.

B. Provide a service log on the inside door of each SEC. Include columns for the following information: date of service, description of work performed, service technician(s), service company in the service log. Place the service log inside a separate clear plastic pocket affixed to the inside door of the SEC.

3.5 DEMONSTRATION

A. On completion of the acceptance test, instruct the owner's representatives, at a time convenient to them, in the operation and testing of the system.

B. Utilize the database for the project during training to give the users a project specific example to learn from.

C. Provide a minimum of 20 hours of on-site training by a factory trained representatives. Maintain a sign in sheet with names and dates of persons trained and forwarded to owner upon completion of training.

D. Provide for two Owner’s representatives to attend factory certification training (off-site) for the following systems:

1. CCTV Recording System

END OF SECTION 28 08 00

SECTION 28 23 00 – VIDEO SURVEILLANCE SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. General: Provide engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction, and special or occasional services as required to make a complete working video surveillance system installation, as described in this specification.

B. Section Includes:

1. CCTV Monitoring and Recording System
2. CCTV fixed cameras
3. CCTV Power supplies
4. Interfaces and connections between CCTV subsystems to allow communication with one another

C. Products Supplied But Not Installed Under This Section:

1. None

D. Products Installed But Not Supplied Under This Section:

1. None

E. Products Specified But Not Installed Under This Section:

1. None

F. Products Furnished and Installed Under Another Section:

1. 120V power
2. Network ports in the Electrical Room for CCTV connectivity via LAN/WAN

G. Related Sections:

1. Consult other Divisions, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete and operable system.
2. Section 280000 Basic Security Requirements: includes general project requirements, submittal formats, installation, and warranty requirements.

3. Section 282600 Security Communications: includes product information for the Blue Light Assistance Phone system integration with the video surveillance system.

4. Section 280513 Security System Cabling: includes product information for wire and cable needed to support the video surveillance system.

5. Section 280553 Security System Labeling: includes label types and formats for security devices.

6. Section 280800 Security Testing: includes the integrating testing/commissioning requirements for the video surveillance system.

1.2 SYSTEM DESCRIPTION

A. CCTV Camera System Overview

1. Provide fixed IP outdoor vandal-proof color CCTV cameras at designated locations in the parking structure as shown on project drawings.

2. Provide a rack-mount Network Video Recorder (NVR) server that provides up to a minimum of 32 cameras and record at 1080p HD, 15 IPS, 30% motion and provide 30 days of storage of all camera views. The camera's must be vandal-resistant and incorporate Wide Dynamic Range technology. Locate the NVR in the Electrical Room on ground floor.

3. Provide built in video motion detection for building perimeter cameras through NVR.

4. Provide fixed CCTV cameras:

   a. Designated areas on drawings

5. Provide KVM switch to call up and view camera images.

6. Provide rack mounted 24 VAC power supplies for the elevator analog camera and blue light assistance phone Blue Strobes.

7. The NVR and blue light assistance telephones will integrate to provide 20 seconds of pre and post alarm event recording.

1.3 SUBMITTALS

A. Contractor Qualifications: Submit certifications for the manufacturers of the video surveillance equipment.

B. Product Data: Submit product information for components specified herein.

C. Shop Drawings:

1. Device placement on floor plans.

2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:

   a. Video surveillance system, monitors, and recording equipment

   b. Devices connected to the system

   c. Miscellaneous control relays

   d. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)

3. Block Diagram/Riser Diagram: Show the video surveillance system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

4. User interface graphics with icons and control buttons displayed.

5. Custom mounting details

1.4 EXTRA MATERIALS

A. Provide 10% spare parts of total installed the following: (Round up to the next complete device)

   1. Cameras (fixed)

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Video Surveillance System

   1. Network Video Recorder

      a. Intransa

      b. Or product similar in design, construction, and performance

   2. Video Management System

      a. OnSSI

      b. Or product similar in design, construction, and performance

   3. Cameras

a. Sony

b. Or product similar in design, construction, and performance

2.2 CCTV IP CAMERAS

A. General

1. Type: Color, Vandal-Resistant with Wide Dynamic Range technology

2. Power: PoE, 24VAC, 12VDC

3. Imager: 1/3 inch format, unless otherwise noted

4. Lens Mount: Accept a “CS” mount auto or manual-iris lens

5. Synch: Adjustable line lock for synchronizing camera to power line. No auxiliary sync cable required.

6. Resolution: Vandal-Resistant 1080p HD, unless otherwise noted

7. Minimum Light Level: 0.1 fc imager illumination at full video, unless otherwise noted

8. Lens: Varifocal 3.1 to 8.9 mm, unless otherwise noted

9. Frame Rate: 15fps at H.264

B. IP Fixed Camera

1. Manufacturer:

a. Sony #SNC-DH240T

b. Or product similar in design, construction, and performance

C. Elevator Fixed Camera

1. Manufacturer:

a. Pelco #IS20/21 Series camera with dome housing

b. Or product similar in design, construction, and performance

2.3 CCTV NETWORK VIDEO RECORDER

A. Features

1. Complete Network Video Recorder platform that encompasses recording video, viewing video, reviewing recorded video, and storing video for 30 days.

2. Full control of camera selections, sequencing, and viewing modes

3. The system simultaneously records, displays live video, and plays back video. None of the video operations interfere with each other. Live view and video playback does not interrupt the recording process.

4. Recorders capture, digitize, and store video. Recorders may record full-time, in response to an alarm, or based on a user-defined schedule. Full-time recording refers to 24 hours per day, 7 days per week, 365 days per year.

5. Network: Internal Ethernet card for connection to a 10/100Base-T LAN.

6. Video Capture: Captures camera signals from fixed cameras. Camera signals may be color, black and white, or both.

7. Web Access: Web based remote access via Internet Explorer 5.0 or higher on Windows 98, ME, NT, 2000, or XP.

8. CPU: (2) Intel Quad-core Xeon 2.4GHz 5600 Series processors.

B. Recorders

1. Use TCP/IP network protocol to communicate to server.

2. Video Information

   a. Store the time, date, and source of the video and be available during playback.

   b. Store for each clip video source, capture date, start time, and stop time. Source identified as either a monitor or a camera.

   c. Store alarm information in the database on the main server when the video is in response to an alarm condition.

3. Recording Configuration

   a. Use TCP/IP network protocol to communicate to head end.

   b. Captures camera signals from fixed cameras. Camera signals may be color, black and white, or both.

   c. Capable of recording video with or without sending the video to tape.

4. Video Storage

   a. NVR to have 20 TB of raw capacity.

   b. Video stored in clips on the recorder’s internal hard drive. As the hard drive becomes full, groom oldest clips to make room for new video.

c. Ability to utilize a variety of network storage devices such as external disk arrays, RAID and NAS devices, and external disk drives for exporting, backup, or sharing images.

d. Ability to specify per camera with respect to recorder and server configurations, length of time video to be store.

5. Video Authentication

a. Fingerprint each video clip through a mathematical algorithm during the video capture process. The fingerprint becomes part of the clip and used by the playback software to verify the video has not been altered.

6. Video Motion Detection

a. Each video input capable of detecting activity from camera input and to initiate an alarm condition.

b. Video motion detection areas operator selectable for each camera input. If the scene changes within the alarm area, an alarm condition is initiated.

7. Viewing of both live and archived images, from multiple remote systems.

8. Ability to call up camera when a call is made from the blue light assistance phones.

9. Password protected via user authorization, with profiles assigned by the system administrator, and database tracking of evens.

C. Manufacturer:

1. Intransa #VA1022-20TB-1

2. Or product similar in design, construction, and performance

2.4 VIDEO MANAGEMENT SOFTWARE

A. Owner will upgrade Access Control Software. Coordinate software integration of Video Management Software with Owner's upgraded Access Control software. Hard wired input/output alarms is not acceptable.

B. Manufacturer:

1. OnSSI Ocularis #OC-IS

2. Or product similar in design, construction, and performance

C. Accessories:

1. #SUP-OC-IS-1Y Software Upgrade Plan, One Year

2. #OC-IS-1C Ocularis-IS IP Device Connection Software License

3. #SUP-OC-IS-1C-1Y Software Upgrade Plan, One Year

2.5 IP VIDEO ENCODER

A. General:

1. Video Compression: Motion JPEG, MPEG-4 Part 2 (ISO/IEC 14496-3), Profiles: ASP and SP

2. Resolution: 4CIF, 2CIFExp, 2CIF, QCI

3. Frame Rate: 15 fps

4. Alarm and event management

5. Channels: 4 minimum

B. Blade Video Server

1. Hot-swappable

2. Built-in, universal power supply

3. Security: IP address filtering and HTTPS encryption

4. Manufacturer:

a. AXIS #243Q blade video server

b. Or product similar in design, construction, and performance

C. Video Server Rack Enclosure

1. High density rack-mount solutions

2. Capable of storing a minimum of 3 interchangeable and hot-swappable blade video servers

3. Manufacturer:

a. AXIS #291 1U video server rack

b. Or product similar in design, construction, and performance

2.6 KVM CONSOLE WITH INTEGRATED LCD MONITOR, KEYBOARD, MOUSE

A. Features

1. Integrated 1x8 KVM switch
2. 17” LCD monitor, 1280 x 1024 resolution minimum
3. Trackball or touchpad mouse
4. Rack mount chassis in a 1U sliding tray
5. Provide cables required for connection to ACAMS and other rack mountable security devices.

B. Manufacturer:

1. Dell # PowerEdge 180AS KVM with Dell # XT912 LCD monitor, keyboard, and touchpad
2. HP # 336044-B21 KVM with HP # TFT7600 LCD monitor, keyboard, and touchpad
3. Or product similar in design, construction, and performance

2.7 CCTV LIGHTNING PROTECTORS

A. Video Line Coaxial Cable Protectors

1. Provide on coaxial cables serving exterior cameras.
2. Manufacturer:
   a. PolyPhaser Corp #IS-75BB/1.5
   b. DITEK
   c. Or product similar in design, construction, and performance

B. Power Line Protectors

1. Provide on power lines serving exterior cameras.
2. Manufacturer:
   a. PolyPhaser Corp #IS-SPTV
   b. DITEK
   c. Or product similar in design, construction, and performance

2.8 POWER SUPPLIES/BATTERY CHARGERS

A. CCTV System Power Supplies

1. 120 VAC input to 24 VAC output, continuous current, fully supervised power supplies for power to cameras.

2. Rack mountable

3. Manufacturer:

   a. Altronix #R2416300UL

   b. Or product similar in design, construction, and performance

PART 3 - EXECUTION

3.1 INSTALLATION

A. CCTV Cameras

1. Field determine exact placement of cameras to ensure complete coverage.

2. Field determine fixed camera lens size to ensure complete coverage.

B. CCTV Power supplies

1. Do not combine with Access Control & Alarm Monitoring System power supplies.

C. CCTV Network Video Recorder

1. Rack mount CCTV equipment located in the Electrical Room.

3.2 PROGRAMMING

A. Prior to the completion of construction schedule a meeting with the Owner to determine the programming criteria. Discuss the following:

1. Camera naming.

2. CCTV camera call-up & recording features (including video motion detection)

B. Document the results of the meeting and perform necessary programming to achieve the Owner's requests.

C. Setup and program the system such that no additional programming required.

D. Use the camera naming convention agreed upon at in the programming meeting when programming point names into the system.

E. Perform 2 full system back-ups at completion of initial programming and deliver one copy to the Owner with a Letter of Transmittal explaining information included in back-

up and brief description of recovery procedures. Perform back-ups on a regular basis through the remainder of the project.

F. Customize menus with the assistance of the factory to “gray-out” features not used on project (such as elevator control).

G. Perform field software changes after the initial programming session to "fine tune" operating parameters and sequence of operations based on revised operating requirements.

3.3 TESTING

A. Test the video surveillance system in accordance with Section 280800.

END OF SECTION 28 23 00

SECTION 28 26 00 – SECURITY COMMUNICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. General: Furnish engineering, labor, materials, apparatus, tools, equipment, transportation, temporary construction and special or occasional services as required to make a complete working blue light assistance phone system, as described in these specifications.

B. Section Includes:

1. Blue Light Assistance Phones

C. Products Supplied But Not Installed Under This Section:

1. None

D. Products Installed But Not Supplied Under This Section:

1. None

E. Products Specified But Not Installed Under This Section:

1. None

F. Products Furnished and Installed Under Another Section:

1. 120V power

2. Phone lines

G. Related Sections:

1. Section 280000 Basic Security Requirements: for submittal format, warranty, general product requirements, enclosure, power supply, miscellaneous relays, and installation requirements.

2. Section 282300 Video Surveillance System: for interface requirements related to the intercom system

3. Section 280513 Security System Cabling: for cable requirements related to the intercom system.

4. Section 280553 Security System Labeling: for device labeling requirements.

5. Section 280800 Security System Testing: for testing requirements related to the intercom systems.

1.2 SYSTEM DESCRIPTION

A. Blue Light Assistance Phones

1. Provide assistance phones in the parking structure at locations shown on project drawings.

2. Provide blue strobe light at each assistance phone location.

3. Coordinate with Owner for telephone dial-up connection

4. Blue light always on. Activation of assistance intercom to cause associated blue light to strobe. Light to remain in strobe function until assistance phone reset.

5. Interface blue light telephone unit with VSS to provide automatic camera call up and recording of activated phone unit.

B. Custom phone Faceplates

1. Provide custom text and color of phone face plate.

1.3 SUBMITTALS

A. Product Data: Submit product information for the intercom systems, including:

1. Assistance Phone Stations

2. Strobe Lights

3. Power Supplies

4. Power Supply Sizing Calculations

B. Shop Drawings: Submit shop drawings containing the following:

1. Device placement on floor plans.

2. Point-to-Point Diagrams: Include wiring, points of connection and interconnecting devices between the following:

a. Assistance Phone Stations

b. Devices connected to the system

c. Miscellaneous control relays

d. Conductors (identify conductors on the point-to-point diagrams with the same tag as the installed conductor)

e. Block Diagram/Riser Diagram: Show the intercom system components, conduit, wire types, and sizes between them, including cabling interties between termination hardware.

3. Custom mounting details.

PART 2 - PRODUCTS

2.1 COMMUNICATIONS DEVICE (PHONE UNIT)

A. Vandal-resistant stainless steel faceplate & metal button.

B. Built-in auto dialer that can call two numbers. If first number doesn't answer or is busy, dials second number.

C. Signage for ADA compliance.

D. Auto-answer to allow security to monitor and initiate calls with Assistance Phone.

E. Options: Ability to automatically identify attendant of location of calling phone by recorded message and digital display.

F. LED indicator for hearing impaired.

G. Auxiliary input and outputs to integrate with CCTV, Blue Light/Strobe, and other devices.

H. Communications Options: IP

I. Phone line-powered: no power supply or battery back-up required.

J. Push button once to call, then speak hands-free.

K. Provide optional message which identifies calling location.

L. Manufacturer and model:

1. Talk-A-Phone #VOIP-500

2. Or product similar in design, construction, and performance

2.2 WALL MOUNT UNIT with blue strobe light

A. Material: 11 gauge brushed stainless steel

B. Weather Resistant: Withstand prolonged exposure to harsh environments.

C. Vandal Resistant

D. Accept flush mounted assistance phone

E. Electrical components hard wired and concealed within the wall mount.

F. The word "ASSISTANCE" emblazoned on both sides in reflective red letters

G. ADA compliant

H. Blue Strobe Light

1. Housed in a vandal resistant, blue polycarbonate refractor housing

2. Refractor housing enclosed in a clear polycarbonate impact-resistant enclosure

3. Light:

a. Minimum 7 watt high efficiency, compact fluorescent light

b. 10,000 hour lifetime

c. Lit at all times

4. Strobe:

a. Minimum 1.5 million candlepower

b. Flash 70 times per minute when assistance phone activated

c. Continue flashing until call completed.

I. Power Requirements: 24 VAC

J. Manufacturer:

1. Talk-A-Phone #ETP-WM/E

2. Or product similar in design, construction, and performance

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Follow installation guidelines set forth in Section 28 00 00 Basic Security Requirements.

B. Assistance Intercoms:

1. Install intercoms and strobe lights, square and plumb.

2. Set "flush mounted" units so that the face of the cover, bezel or escutcheon located in the same plane as the surrounding finished surface.

3. Mount so that there are no gaps, cracks or obvious lines between the trim and the adjacent finished surface and ready them to receive final finish, as applicable.

3.2 PROGRAMMING

A. Prior to the completion of construction, schedule a meeting with the Owner to determine of the programming criteria. Discuss the following issues:

1. Phone Numbers

2. Backup Phone Numbers

3. CCTV camera call-up & recording requirements on activation of assistance phone

3.3 TESTING

A. Test the blue light assistance phone system in accordance with Section 280800.

END OF SECTION 28 26 00

SECTION 28 31 11 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Remote annunciator.
7. Addressable interface device.
8. Digital alarm communicator transmitter.

1.3 DEFINITIONS

A. LED: Light-emitting diode.

B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

1.6 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
   a. Include battery-size calculations.
3. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
4. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
5. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire-alarm system design.
   b. NICET-certified fire-alarm technician, Level III minimum.
   c. Licensed or certified by authorities having jurisdiction.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.8 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
   a. Frequency of testing of installed components.
   b. Frequency of inspection of installed components.
   c. Requirements and recommendations related to results of maintenance.
   d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.9 MAINTENANCE MATERIAL SUBMITTALS

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

1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
2. Smoke Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.

3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.

4. Keys and Tools: One extra set for access to locked and tamperproofed components.

5. Audible and Visual Notification Appliances: One of each type installed.

1.10 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

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

E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.11 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning with Substantial Completion, provide software support for two years.

C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.

1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. 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:

1. AMSECO - a Potter brand; Potter Electric Signal Company.

2. Bosch Security Systems.
3. Commercial Products Group/CPG Life Safety Signals.
4. Faraday; Siemens Building Technologies, Inc.
5. Federal Signal Corporation.
6. Fire Control Instruments, Inc.; a Honeywell company.
7. Fire Lite Alarms; a Honeywell company.
8. GAMEWELL; a Honeywell company.
9. GE Infrastructure; a unit of General Electric Company.
10. Gentex Corporation.
11. Harrington Signal, Inc.
12. NOTIFIER; a Honeywell company.
13. Siemens Building Technologies, Inc.; Fire Safety Division.
14. Silent Knight; a Honeywell company.
15. SimplexGrinnell LP; a Tyco International company.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Verified automatic alarm operation of smoke detectors.
5. Automatic sprinkler system water flow.
6. Heat detectors in elevator shaft and pit.
7. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Activate voice/alarm communication system.
5. Recall elevators to primary or alternate recall floors.
6. Activate emergency lighting control.
7. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

2.3 FIRE-ALARM CONTROL UNIT

A. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864 and listed and labeled by an NRTL.
   a. System software and programs shall be held in flash electrically erasable programmable read-only memory (EEPROM), retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
2. Addressable initiation devices that communicate device identity and status.
   a. Smoke sensors shall additionally communicate sensitivity setting and allow for adjustment of sensitivity at fire-alarm control unit.
   b. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components

including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 1 line of 40 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Initiating Device, Notification Appliance, and Signaling Line Circuits: NFPA 72, Class A.
   a. Initiating Device Circuits: Style D.
   b. Notification Appliance Circuits: Style Z.
   c. Signaling Line Circuits: Style 2.
   d. Install no more than 50 addressable devices on each signaling line circuit.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an NRTL-listed and -approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Elevator Recall:

1. Smoke detectors at the following locations shall initiate automatic elevator recall. Alarm-initiating devices, except those listed, shall not start elevator recall.
   a. Elevator lobby detectors except the lobby detector on the designated floor.
   b. Smoke detector in elevator machine room.
   c. Smoke detectors in elevator hoistway.
2. Elevator lobby detectors located on the designated recall floors shall be programmed to move the cars to the alternate recall floor.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
   a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.

1. Indicated number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711 and be listed by an NRTL.
   a. Allow the application of and evacuation signal to indicated number of zones and, at same time, allow voice paging to the other zones selectively or in any combination.
   b. Programmable tone and message sequence selection.
   c. Standard digitally recorded messages for "Evacuation" and "All Clear."
   d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification appliance circuits of fire-alarm control unit.
2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly

describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.
3. Indoor Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
   a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
   b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).

c. Provide multiple levels of detection sensitivity for each sensor.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.

2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

2.6 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).

1. Mounting: Adapter plate for outlet box mounting.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.

C. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.

3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.

4. Flashing shall be in a temporal pattern, synchronized with other units.

5. Strobe Leads: Factory connected to screw terminals.

6. Mounting Faceplate: Factory finished, red.

2.8 REMOTE ANNUNCIATOR

A. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.

1. Mounting: Surface cabinet, NEMA 250, Type 1.

B. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.9 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

2.10 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632 and be listed and labeled by an NRTL.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.

C. Local functions and display at the digital alarm communicator transmitter shall include the following:

1. Verification that telephone line is available.
2. Programming device.
3. LED display.
4. Manual test report function and manual transmission clear indication.
5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
1. Address of the alarm-initiating device.
2. Address of the supervisory signal.
3. Address of the trouble-initiating device.
4. Loss of ac supply or loss of power.
5. Low battery.
6. Abnormal test signal.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.11 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Equipment Mounting: Install fire-alarm control unit on concrete base with tops of cabinets not more than 72 inches (1830 mm) above the finished floor. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
1. Install seismic bracing. Comply with requirements in Section 260548 "Vibration and Seismic Controls for Electrical Systems."
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 concrete base.

3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use 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.

C. Equipment Mounting: Install fire-alarm control unit on finished floor with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

D. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

1. Comply with requirements for seismic-restraint devices specified in Section 260548 "Vibration and Seismic Controls for Electrical Systems."

E. Smoke- or Heat-Detector Spacing:

1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.

2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for heat-detector spacing.

3. Smooth ceiling spacing shall not exceed 30 feet (9 m).

4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Appendix A in NFPA 72.

5. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture.

F. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches (150 mm) below the ceiling.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.

L. Fire-Alarm Control Unit: Surface mounted, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

M. Annunciator: Install with top of panel not more than 72 inches (1830 mm) above the finished floor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to elevator recall system and components.
2. Alarm-initiating connection to activate emergency lighting control.
3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
5. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.5 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 28 31 11

SECTION 31 10 00
SITE CLEARING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Section includes: Elements indicated on the Drawings as applicable, including the following:

1. Clearing of plant life, trees and grass, surface rocks and debris.

2. Removal of minor existing construction within the Project limits including, but not limited to:
   a) Sawcutting and removal of asphaltic concrete and Portland Cement Concrete (PCC) paving, including curbs, sidewalk, gutters, etc.
   b) Site structures including foundations.
   c) Removal of site drainage and utility systems.
   d) Removal of fencing and gates.
   e) Removal of trees and vegetation.

3. Grubbing of root systems of trees and shrubs, abandoned utility lines and structures and other below ground structures.

4. Protection of trees, landscaping, site improvements, utilities and other items not scheduled for clearing or that might be damaged by construction activities.

5. Handling and disposal of debris.

6. Dewatering of excavations as necessary to control surface and ground water.

B. Contractor shall provide all labor, materials, tools, equipment, and incidentals to perform all earthwork operations as indicated on the drawings and specified herein, including but not limited to site grading, excavation, material import, backfill, soil compaction control, finish grading and removal and disposal of excess or unsuitable materials.

C. Costs incurred due to repair, restoration, or replacement of existing improvements which are not designated for removals which are damaged as a result of construction operations shall be the responsibility of the Contractor.

D. Related Sections:

1. Section 31 22 00 - Grading

1.02 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable Codes, ordinances and regulations of authorities having jurisdiction, including noise, dust and run-off control and disposal of debris.

B. Utility Requirements: Coordinate Work with applicable utility agencies and companies.

C. Work of this Section shall be carefully performed by worker skilled in similar demolition activities, using appropriate tools and equipment, under supervision of a competent supervisor at all times.

1.03 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain on the property, demolished materials shall become the Contractor's property and shall be removed from the site and properly disposed by the Contractor.

1.04 SUBMITTALS

A. Photographs or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by demolition activities.

B. Schedule of selective demolition activities indicating the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of City's on-site operations.

C. Inventory of items to be removed and salvaged.

D. Inventory of items to be removed by City.

E. Record drawings at Project closeout.

1. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.
2. Landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.05 PROJECT CONDITIONS

A. Drawings may not indicate in detail all demolition work to be carried out. Contractor shall carefully examine existing work to determine full extent of demolition required for completed work to conform to Drawings and Specifications.

B. Conduct selective demolition so that adjacent operations and buildings will not be disrupted. Provide not less than 72 hours' notice to City and Engineer of activities that will affect adjacent operations.

C. Asbestos: If any materials suspected of containing asbestos are encountered, do not disturb the materials. Immediately notify City and Engineer.

D. Lead based paint: Notify City and Engineer of any lead based paint should it be encountered.

E. Storage or sale of removed items or materials on-site will not be permitted.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Use repair materials identical to existing materials.

1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
2. Use materials for which the installed performance equals or surpasses that of existing materials.

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 selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to City and Engineer.

E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

F. Locate and clearly flag trees and vegetation to remain or to be relocated.

G. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

3.02 UTILITY SERVICES

A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Do not interrupt existing utilities serving occupied or operating facilities, except when authorized in writing by City and Engineer and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to City and Engineer and to governing authorities.

    a. Provide not less than 72 hours' notice to City and Engineer if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building or area to be selectively demolished.

1. City and Engineer will arrange to shut off indicated utilities when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.

4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.

C. Utility Requirements: Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. 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 City, City and Engineer and authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by governing regulations. Provide barricades and/or flagmen to control traffic flow. Submit traffic control plans for approval by City prior to altering existing traffic patterns.

C. Conduct demolition operations to prevent injury to people and damage to adjacent buildings and facilities to remain. Ensure safe passage of people around selective 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.

3.04 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. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

B. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

C. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations frequently and as directed by City. Return adjacent areas to condition existing before start of selective demolition.

3.05 SELECTIVE DEMOLITION

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:

1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

4. Maintain adequate ventilation when using cutting torches.
5. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
6. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Demolish concrete and masonry in small sections. Cut concrete and masonry at junctures with construction to remain, using power-driven masonry saw or hand tools; do not use power-driven impact tools.

C. Break up and remove concrete slabs on grade, unless otherwise shown to remain.

3.06 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.

1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. 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 an 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.

D. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by City and Engineer.

1. Employ a qualified arborist, licensed in California, 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 and approval of City.

3.07 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.
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 18 inches below exposed subgrade.
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.

1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.08 PATCHING AND REPAIRS

A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

3.09 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. Disposal: Transport demolished materials off City's property and legally dispose of them.

3.10 CLEANING

A. Sweep the work areas broom clean on completion of demolition operations, each day as necessary or as requested by City.

END OF SECTION 31 10 00

SECTION 31 22 00
GRADING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Contractor shall provide all labor, materials, tools, equipment, and incidentals to perform all earthwork operations as indicated on the drawings and specified herein, including but not limited to site grading, shoring, excavation, material import, backfill, soil compaction control, finish grading and removal and disposal of excess or unsuitable materials.

B. Costs incurred due to repair, restoration, or replacement of existing improvements which are not designated for removals which are damaged as a result of construction operations shall be the responsibility of the Contractor.

C. Contractor will be responsible to provide all surveying services required for this project. Survey work will be completed by a Professional Land Surveyor, licensed to practice in the State of California.

1.02 REFERENCES

A. Codes and Standards
   a. Standard Specifications for Public Works Construction (SSPWC), Latest Edition
   b. California Building Code, Latest Edition

B. Project Geotechnical Investigation and Report

1.03 PROTECTION OF PROPERTY

A. Contractor shall furnish, place, and maintain all shoring and bracing in accordance with California OSHA requirements and as may be required for protection of existing structures, streets, and other adjacent facilities during proper execution of work. The adequacy of and responsibility for protection shall be the Contractor's. Shoring and bracing systems shall be designed by a Structural Engineer currently licensed to practice in California.

B. All bench marks, monuments and other reference points shall remain undisturbed unless specifically allowed by the City.

C. When hauling is done over public streets, loads shall be trimmed and material shall be removed from shelf areas of vehicles to eliminate spilling.

1.04 PROTECTION OF PUBLIC

Contractor shall provide such barricades, temporary fences, lights, warning signs, guards, and other measures as may be necessary to assure safety and to deter trespassers. These temporary facilities shall be constructed, painted and maintained in strict conformance with the requirements of applicable local and State codes.

1.05 DIG ALERT NOTIFICATION

A. Before grading, the Contractor must contact the Underground Service Alert of Southern California (Dig Alert) at 811 for information on buried utilities and pipelines.

B. Delineation of the proposed excavation site is mandatory. Mark the area to be excavated with water soluble or chalk based white paint on paved surfaces or with other suitable markings such as flags or stakes on unpaved areas.

C. Call at least two (2) full working days prior to digging.

D. A permit for digging will not be valid without a Dig Alert ticket number.

E. California Government Code 4216 requires you to hand expose to the point of no conflict 24" on either side of the underground facility, so you know its exact location before using power equipment.

1.06 PROJECT CONDITIONS

A. Information on Drawings or in soil investigation report does not constitute a guarantee of accuracy or uniformity of soil conditions over the Project site.

B. Existing Utilities: Do not interrupt existing utilities serving facilities occupied by City or others except when permitted in writing by the City and then only after acceptable temporary utility services have been provided.

C. Where subsurface utilities are shown on the plans to be removed, the Contractor, at its option, may either completely remove or abandon said utility in place. However, the Contractor shall completely remove said utility beneath any proposed building or where said utility would interfere with any proposed improvement (including landscaping). Should the Contractor elect to abandon any utility in place he shall completely backfill said utility with 1-1/2 sack sand-cement slurry mixture. Coordinate with utility companies to shutoff services if lines are active. Backfill of utility trenches shall be in accordance with grading and compact requirements for the building footprint as detailed in the project geotechnical report.

D. Noise and Dust Abatement: Exercise all reasonable and necessary means to abate dust, dirt rising and undue noise. Perform necessary sprinkling and wetting of construction site to allay dust as required by applicable codes and ordinances.

PART 2 – PRODUCTS

2.01 SOIL MATERIALS

A. All soils materials to be used throughout the site shall be approved for use by City and/or geotechnical testing engineer. Provide approved borrow soil materials from off-site when sufficient approved soil materials are not available from excavations.

B. The Contractor is solely responsible for verifying the earthwork quantities necessary to complete the project. As is the case with every project, contingencies should be made to adjust the earthwork balance when grading is in-progress and actual conditions are better defined.

C. Satisfactory Soil Materials: Soils in accordance with the project geotechnical report and approved by the testing geotechnical engineer.

D. Buried Pipe Warning and Locator Tape: Tape shall be plastic film specifically formulated for prolonged underground use with minimum thickness of 4 mils. Tape shall also include a metallic substance that can be registered by a magnetic field location device. Tape shall indicate the specific type of buried pipe.

PART 3 – EXECUTION

3.01 GRADING OPERATIONS

A. Finish grades and surfaces in all cases shall conform to the lines, grades, cross sections and dimensions indicated on the drawings. Such deviations from the drawings, as may be required by the exigencies of construction, will in all cases be determined by City and Engineer and authorized in writing. Contractor shall submit project Request for Information (RFIs) to both City and Engineer simultaneously.

B. Finished grades shall be well compacted, reasonably smooth and insuring positive drainage, free of abrupt grade changes, irregularities, water pockets, or discontinuities in surface level.

C. Subgrade for pavements, sidewalks, curbs, gutters, and other structures shall not vary more than one-half inch (1/2") from the grade and cross-section as indicated on the drawings.

D. Adequate drainage shall be provided throughout the progress of the work so that storm water will be treated and disposed of without damage to the project or adjacent properties. Costs incurred due to repair, restoration, or replacement resulting from such damage shall be the responsibility of the Contractor.

E. After required excavations, undisturbed or exposed natural soils in areas to be planted shall be cross-ripped to a depth of twelve inches (12") and brought to within three percent (3%) of optimum moisture and compacted. Teeth on ripper shall be twelve inches (12") on center.

F. All finish grading shall be completed prior to weed abatement operations, soil preparation, and planting as specified in the Landscape Planting specifications. The City, at its own expense, may require a soils test at the completion of grading operations.

G. No finish grading shall be done when the moisture content of the soil is so great that excessive compaction will occur, nor when it is so dry that dust will form in the air or that clods will not break readily.

H. Prior to completion of finish grading, all rocks, roots or other foreign material one inch (1") or larger in any dimension and weeds shall be removed from the top two inches (2") of the finish grade.

I. All work shall conform to the lines, elevations, and grades shown on the Construction Plans. Three consecutive points set on the same slope shall be used together so that any variation from a straight grade can be detected. Any such variation shall be reported to the Engineer. In the absence of such report, the Contractor shall be responsible for any error in the grade of the finished work.

J. Protect and maintain stakes in place until their removal is approved by the City and Engineer. Grade or location stakes lost or disturbed by Contractor, shall be reset by the Surveyor at the expense of Contractor.

3.02 EXCAVATION

A. Excavations shall be to the dimensions and elevations indicated on the drawings of sufficient width to provide clearances for setting of forms and inspections of the various classifications of work in accordance of applicable State and Federal regulations.

B. Bottom of excavations shall be level, free form loose material, and to the required levels in undisturbed earth. All excavations shall be kept free from standing water. Contractor shall assume all responsibility for pumping or draining that may be necessary in carrying on the work.

C. In the event an excavation is five feet (5') or more in depth, Contractor shall cause a competent person to be placed at the site of the work for purpose of observing backfilling operations where the operator of a power unit engaging in such backfilling is unable to see into the excavation.

D. Excavations made to greater depths than indicated without specific direction shall be backfilled with concrete as specified for foundations at the Contractor's expense.

E. Acceptable excavated material as determined by City and Geotechnical Engineer shall be transported to and placed in fill areas within the limits of work.

F. Do not use explosives.

G. Excavation is unclassified and includes excavation to required subgrade elevations regardless of the character of materials and obstructions encountered.

H. Should utilities and other below-grade conditions be encountered which adversely affects the Work, discontinue affected Work and notify City and Engineer for direction. Unforeseen conditions will be resolved in accordance with provisions of the Conditions of the Contract.

3.03 COMPACTED FILL

A. Graded material shall not be left in loose layers but shall be compacted in thin layers.

B. Fill material shall be composed of satisfactory excavated material or approved imported soil and shall be evenly spread in uniform continuous horizontal layers not more than six inches (6") deep of uncompacted thickness unless otherwise stated in the project geotechnical report.

C. Each uncompacted layer shall be moistened or aerated as necessary to obtain an even moisture distribution within three percent (3%) of optimum moisture content. Compaction shall be performed by suitable mechanical equipment as approved by the City and Geotechnical Engineer. Each layer of fill shall be sufficiently roughened after compaction to ensure bonding to the succeeding layer.

D. Each lift and the upper six inches (6") of natural soils shall be compacted to at least eighty-five percent (85%) of maximum density obtainable in areas designated for planting and at least ninety percent (90%) maximum density obtainable in areas designated to receive pavement, structures and site amenities in accordance with ASTM D-1557.

E. Bring fills to an elevation above required grade to allow for shrinkage and settlement.

3.04 BACKFILL

A. Trenches and areas adjacent to footings and foundations shall not be backfilled until the work is inspected and approved by City and Geotechnical Engineer.

B. Trenches shall be compacted in accordance with the requirements for compacted fill as specified herein.

C. Trenches that settle below grade shall be reopened to a depth required for proper compaction, refilled and compacted to the indicated surface elevation, allowing for shrinkage and settlement.

D. Excavated material, approved for backfilling, shall be free from large clods, stones and other objectionable materials, exceeding one inch (1") in diameter; and deposited in accordance with the requirements for compacted fill as specified herein.

E. Compaction of backfill by ponding and jetting will not be permitted.

3.05 EXCESS or UNSUITABLE MATERIALS

A. As requested by City, excess excavated materials shall be removed from the project site. Contractor shall make arrangements for disposal of the material at off-site locations with City's written consent of the property upon which such material will be disposed.

B. Satisfactory completion of fill areas shall be completed before disposing of any indicated surplus material. A shortage of material cause by premature disposal shall be replaced at Contractor's expense.

C. Unsuitable material as determined by the Geotechnical Engineer, encountered below the natural ground surface during construction, and not indicated on the drawings, shall be excavated and disposed of off the project site. Contractor shall replace such unsuitable materials with satisfactory material as directed by City and Geotechnical Engineer.

3.06 IMPORTED FILL

A. Imported fill shall be agricultural suitable, clean, free from organic materials, trash, debris, rubbish or other objectionable substances. Contractor shall verify with City and Geotechnical Engineer the specific removal site. Prior to delivery to the project site, soil shall be tested for agricultural suitability by a method approved by City and Engineer.

B. Imported fill shall be placed as specified herein as to the minimum relative compaction and placement method.

C. Imported fill, along with the existing site material, shall be thoroughly spread and mixed prior to rough grading operations.

D. Imported soil shall be subject to inspection and agricultural soil testing prior by City and Geotechnical Engineer at the source of supply prior to delivery to the project site.

3.07 APPROVAL OF SUBGRADE

A. Notify City and Geotechnical Engineer when excavations have reached required over-excavation subgrade.

B. When City and Geotechnical Engineer determines that unforeseen unsatisfactory soil is present, continue work only after receiving direction from City and Geotechnical Engineer.

C. Reconstruct subgrades damaged by rain, accumulated water or construction activities as directed by the City and Geotechnical Engineer.

3.08 UNAUTHORIZED EXCAVATION

A. Fill of unauthorized excavation below bottoms of foundations or wall footings will be engineered fill.

B. Fill unauthorized excavations under other construction as directed by City and Geotechnical Engineer.

C. Where indicated widths of utility trenches are exceeded, provide stronger pipe, or special installation procedures, as required by City, Geotechnical Engineer and Engineer.

3.09 STORAGE OF SOIL MATERIALS

A. After the site has been stripped of all debris, vegetation and organic materials, excavated on site soils may be reused for engineered fill provided the organic content does not exceed 3 percent. High in-site moisture contents will require aeration prior to placement as engineered fill. Rocks or chunks of concrete or asphalt greater than 8 inches in any dimension shall not be incorporated into engineered fill.

B. 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. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees. Cover to prevent wind-blown dust.

3.10 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or lose compaction due to subsequent construction operations or weather conditions. Scarify or remove and replace material to depth directed by the Geotechnical Engineer; reshape and recompact 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.

3.11 DISPOSAL OF SURPLUS WASTE MATERIALS

A. Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris and legally dispose of it off City's property.

END OF SECTION 31 22 00

SECTION 32 05 23 - CEMENT AND CONCRETE FOR EXTERIOR IMPROVEMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-In-Place concrete pedestrian paving and sidewalks.
   2. Curbs and gutters.
   3. Concrete stairs, landing, ramps and detectable warning texture.
   4. Light standard bases, fence post bases, flagpole bases and similar site structures.
   5. Utility concrete pads.
   6. Perimeter concrete curbing, mow strips, concrete drainage structures, swales.
   7. Thrust Blocks.

B. Related Sections include the following:
   1. Division 03 Section 03 30 00 “Cast-in-Place Concrete” for general building applications of concrete.
   2. Division 31 Section 31 20 00 “Earthmoving” for subgrade preparation, grading, and subbase course.
   3. Division 32 Section 32 12 16 “Asphalt Paving” for base course.

1.2 REFERENCES

A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials.

B. ACI 318 - Building Code Requirements for Structural Concrete and Commentary, 2003 Edition.

C. ASTM A185 - Steel Welded Wire Reinforcement, Plain, for Concrete.

D. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

E. ASTM C33 - Concrete Aggregates.

F. ASTM C94 - Ready-Mixed Concrete.

G. ASTM C150 - Portland Cement.

H. ASTM C171 - Sheet Materials for Curing Concrete.

I. ASTM C309 - Liquid Membrane-Forming Compounds for Curing Concrete.

J. ASTM C920 - Elastomeric Joint Sealants.

K. ASTM C979 - Pigments for Integrally Colored Concrete.

L. ASTM C1107 - Packaged Dry, Hydraulic - Cement Grout (Non-Shrink).

M. ASTM D1751 - Preformed Expansion Joint Fillers for Concrete, Paving and Structural Construction.

N. California Code of Regulations Title 24 Part 1 and 2

O. CBC - 2007 California Building Code and Supplements
   1. CBC-11 – CBC Chapter 11B, Accessibility Requirements for Public Buildings, Public Accommodations, Commercial Facilities and Publicly Funded Housing
   2. CBC-17 – CBC Chapter 17, Structural Testing and Special Inspections
   3. CBC-19 – CBC Chapter 19[A], Concrete

P. CACRM - California Access Compliance Reference Manual, updated July 1, 2008 and based on 2007 California Building Code.

1.3 SUBMITTALS

A. Placement Schedule for approval: Provide details or sketches showing location of each placement of concrete Work. Do not deviate from location of expansion joints or score lines.

B. Product data on joint filler, sealants, curing compounds and reinforcing.

C. Project Record Documents
   1. Accurately record actual locations of embedded sleeves, utilities and components that are concealed from view.

D. Submit Certification of experience for Color Stain finisher.

1.4 REGULATORY REQUIREMENTS

A. CACRM - California Access Compliance Reference Manual, updated July 1, 2008, based on the 2007 California Building Code, CBC Sections 1133B.7.1.1, 1133B.7.2.

1.5 QUALITY ASSURANCE

A. Maintain one copy of all records on site.

B. Acquire cement and aggregate from same source for all Work.

C. Conform to Section 1905A.13, California Building Code, when placing concrete during hot weather.

D. Conform to Section 1905A.12, California Building Code, when placing concrete during cold weather. No placement of concrete permitted below 50 degrees Fahrenheit.

E. Mock-up
   1. Install minimum 5 feet by 5 feet mock-up of concrete sidewalk for each surface treatment specified.
   2. Install mock-up one month prior to installation.
   3. Locate as approved by the Architect.
   4. Use identical forming system, sub-grade type, reinforcing, expansion joints, score joints, finishing and edge trim as specified for installation.
   5. Architect approval required.
   6. Mock-up may not be used in final installation.
   7. Remove mock-up materials from site and dispose legally.

1.6 EXTENDED WARRANTY

A. Manufacturer shall warrant prefabricated detectable warning texture products against failure in materials or workmanship for at least the specified warranty periods. Upon written notice from Owner manufacturer shall promptly, without cost, and with least practicable inconvenience to Owner correct such defects.
   1. Failures include, but are not limited to, significant degradation in color fastness, conformation, sound-on-cane acoustic quality, resilience, and attachment will not degrade significantly.
      a. Significant degradation means that product loses 10 percent or more of its approved design characteristics, as determined by the authority having jurisdiction.
   2. Minimum Warranty Period: 5 years from date of Certified Completion.

PART 2 - PRODUCTS

2.1 CONCRETE MATERIALS

A. Cement: ASTM C150 - Type I - Normal or Type II - Moderate, Portland Cement type, from one manufacturing plant only.

B. Aggregates: ASTM C33, single source for all materials. Maximum size aggregate: 1 inch.

C. Non-Shrink Grout: ASTM C1107, premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 4,000 psi in 24 hours and 7,500 psi in 7 days unless otherwise indicated on Drawings; of consistency suitable for application and a 30 minute working time.

2.2 ACCESSORIES

A. Slip Resistant Finish: Dry shake type aluminum oxide abrasive grains, hardness No. 9 on Mohr's scale; Emery Non-slip, manufactured by Dayton Superior, Kansas City, KS, Emery Aggregate manufactured by Oregon Emery Co., Halsey OR, or equal as approved in accordance with Division 01, General Requirements for Substitutions.

B. Detectable Warning Texture: Compliance with CBC Sections 1133B.8.3 through 1133B.8.5, IRs 11B-3 and 11B-4 and the California Accessibility Reference Manual.
   1. Truncated Domes: provide raised Detectable Warnings with diameter of 0.9 inch at base tapering to 0.45 inch at top, height of 0.2 inch, with center-to-center spacing of 1.67 inches and corner domes spaced at 0.896 inch from the corner edges of tile. Provide raised truncated domes in a square grid (in-line) pattern.
      a. Truncated Dome: shall contrast visually with adjoining surfaces, light-on-dark or dark-on-light. Material used to provide contrast shall be integral part of walking surface. Warning surface shall differ from adjoining surface in resiliency or sound to cane contact.
   2. Detectable Warning Texture (Truncated Domes): Paver Tiles: 12 by 12 inches unless noted otherwise on drawings, with pre-formed fastener locations.
      a. Pavers: Refer to Section 321413.

2.3 CONCRETE MIX

A. Mix and deliver concrete in accordance with Section 1905A, California Building Code. Deliver concrete in transit mixers only. Mix concrete for 10 minutes minimum at a peripheral drum speed of approximately 200 feet per minute. Mix at jobsite minimum 3 minutes. Discharge loads in less than 1-1/2 hours or under 300 revolutions of the drum, whichever comes first, after water is first added.

1. Design Mix:
   a) Conform to Section 1905A.3, 2007 California Building Code for Proportioning on the basis if field experience or trial mixtures method.
2. Do not exceed 0.50 water-cement ratio by weight for floor slabs and for other concrete.
3. Quantities of Materials: Weighmaster's records not required for sitework concrete.
4. Required Strength: Minimum 2,500 psi for sitework concrete.

2.4 FORMS

A. Conform to Section 1906A.1 and 1906A.2, California Building Code.

B. Plywood Forms: APA - Medium density overlay, Group 1, Exterior, PS-1, for exposed surfaces. APA Plyform B-B, Class 1, Exterior, PS-1 for unexposed surfaces.

1. Use flexible or curved forms for curves with a radius 100 feet or less.

C. Lumber: Douglas Fir species, construction grade, Surfaced Lumber, with grade stamp clearly visible for smooth and straight exposed surface.

D. From Release Agent; commercially formulated form-release agent that will not bond with, stain or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.5 CURING MATERIALS

A. Polyethylene Film ASTM C171; 10 mil thick, clear, manufactured from virgin resin with no scrap or additives, manufactured by Burke-Edoco, Long Beach, CA, or equal as approved in accordance with Division 01, General Requirements for Substitutions.

B. Water: Potable and not detrimental to concrete.

C. Curing Compound: ASTM C309, Type 2, Class A; wax resin base, Burke Wax Emulsion White curing compound, by Burke-Edoko, Euclid Chemical Co. or equal as approved in accordance with Division 01, General Requirements for Substitutions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions.

B. Verify requirements for concrete cover over reinforcement.

C. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely and will not cause hardship in placing concrete.

3.2 PREPARATION

A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

B. In locations where new concrete is doweled to existing Work, drill holes in existing concrete, insert steel dowels and pack solid with non-shrink grout.

3.3 PLACING CONCRETE (GENERAL)

A. Convey and deposit concrete in accordance with Section 1905A.9 and 1905A.10, California Building Code. Remove loose dirt from excavations.

B. Notify Job Inspector minimum 24 hours prior to commencement of operations.

C. Ensure reinforcement, inserts, embedded parts, formed joint fillers, joint devices and accessories are not disturbed during concrete placement.

D. Ensure sub-base or base materials have been compacted or otherwise treated.
   1. Sub-base and base preparation per Section 312316 Excavation and Section 312323 for Backfilling.
   2. Remove unsuitable soil, backfill with clean compactable soil or approve granular material to required elevations.
   3. Scarify exposed natural sub-base to depth of 6 inches. Bring to optimum moisture content and re-compact to 90 percent in accordance with ASTM D 1557.
   4. Add approved base to required elevation in 6 inch maximum lifts. Bring to optimum moisture content and compact to 90 percent in accordance with ASTM D1557.

E. Install joint fillers, primer and sealant in accordance with manufacturer's instructions.

F. Place concrete continuously between predetermined expansion joints.

G. Do not interrupt successive placement; do not permit cold joints to occur. Avoid segregation of materials. Perform tamping and vibrating so as to produce a dense, smooth application free of rock pockets and voids. Do not use vibrators to move concrete horizontally.

H. Do not allow concrete to fall free from any height which will cause materials to segregate. Maximum height of free fall permitted in any case: 5 feet.

I. Defective Installation: Repair and clean at Contractor's expense all concrete damaged or discolored during construction. Where concrete requires repair before acceptance, the repair shall be made by removing and replacing entire section between joints and not by refinishing the damaged portion.

J. Proper curing of concrete surfaces is the responsibility of the Contractor. Concrete failing to meet specified strength shall be removed and replaced.

3.4 ON-SITE CONCRETE SIDEWALKS, PEDESTRIAN PAVED AREAS AND RAMPS

A. Forms, Wood: Free from warp, with smooth and straight upper edges, surfaced one side, minimum thickness 1-1/2 inches adequate to resist springing or deflection from placing concrete.

B. Forms, Metal: Gage sufficient to provide rigidity and strength equivalent to wood.

C. Reinforcing Steel: #4 bars, place bars at 12 inches on center each way for sidewalks and paved areas and #4 bars for edges unless otherwise indicated on Drawings.

D. Reinforcement: Provide welded steel wire fabric, 6 inches by 6 inches, No. 10 gage at middle of slab for sidewalks and ramps. Interrupt reinforcement at expansion joints.

E. Concrete Placement: Dampen subgrade to retain moisture in concrete mix. Tamp and spade to consolidate concrete for entire length of pour. Strike off upper surface to specified grades.

F. Isolation Joints: Locate at slabs abutting vertical concrete surfaces and as patterned on drawings. Install vertically, full depth of concrete with preformed joint filler recessed for plastic cap at 1/2 inch depth at top for sealant application.

1. Doweled Isolation Joints at Heavy Vehicle Driveways and Parking: At abutting building foundations; provide 1/2-inch diameter smooth steel dowels 14 inches long, one end of dowel lubricated and set in capped sleeve to allow for longitudinal movement, spaced at 24 inches on center maximum, 6 inches from edges.
2. Monolithic Curb and Gutter: No expansion joints required between gutter and curb face.

G. Expansion Joints: Locate maximum 24 feet centers and as patterned on drawings. Install vertically, full depth of concrete, install preformed joint filler recessed for plastic cap at 1/2 inch depth at top for sealant application.

1. Monolithic Curb and Gutter: No expansion joints required between gutter and curb face.

H. Contraction/Crack Control Joints: At 8 feet each way at concrete paved areas, and 5 feet at sidewalks, tool joint with 1/2 inch radius, depth 1/4 the thickness of slab but not less than 1 inch deep. Refer to drawings for required design patterns.

I. Curb Ramps: Form grooves, flush to finished surfaces, 12" wide border. Grooves at 1/4" deep, 1/4" wide and at 3/4" on centers, at 3 sides on level surface of the sidewalk. Provide patterns as indicated in drawings. Detectable Warnings at Curb Ramps per IR 11B-2 and 11B-3, 11B-4 CBC 1127B.5.7.

1. Detectable warning required at ramps (non-curb) less than 1:15 (6.7% slope).
2. Detectable Warnings at ramp surface and all Curb Ramps – Truncated Domes
   a. Set Paver Truncated Dome products in full mortar bed per Section 32 14 13 Unit Pavers and as indicated on drawings.
   a. Plastics/Composites: Cast in place plastic tiles per manufacturer's instructions and in accordance with CBC.
   b. Form bottom edge flush and free of abrupt changes, DSA IR 11B-2.

J. Finish:

1. Screed concrete to required grade, float to a smooth, flat, uniform surface. Edge all headers to 1/2 inch radius. Edge expansion joints to 1/4 inch radius. Steel trowel to hard surface.

2. Grades less than 6 percent: shall conform to Section 1133B.7.1.1. After final troweling, apply a medium broom finish transverse to centerline or direction of traffic.
3. Grades exceeding 6 percent: shall conform to Section 1133B.7.1.2. After final troweling, apply a heavy broom finish transverse to centerline or direction of traffic
4. Walkway grades in excess of 5 percent shall conform to requirements of Section 1133B.7.3, California Building Code.

K. Curing: Cure surfaces utilizing one of the following methods:
1. Spraying: Spray water over slab areas and maintain wet for 7 days, use burlap mats.
2. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
3. Apply liquid curing compound at rate of 200 SF per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units of any kind.

L. Remove expansion joint plastic caps. Prime both sides of joint and apply self-leveling sealant per Section 079200. Provide smooth concave surface.

3.5 LIGHT STANDARD BASES, FENCE POST BASES, FLAGPOLE BASES, MISCELLANEOUS SURFACES, UTILITY PADS AND SIMILAR SITE STRUCTURES.

A. Forms: Suitable material and type, size, shape, quality and strength to insure construction as designed, true to line and sufficiently rigid to resist deflection during placing of concrete. Clean forms of all dirt, mortar and foreign matter before use.

B. Reinforcement: Place accurately and hold in position, using metal chairs, spacers, metal hangers, supporting wires and other devices of sufficient strength to resist crushing under full load. Clean reinforcing steel of mortar, oil, dirt, loose mill scale loose or thick rust and coatings.

C. Coordinate installation of conduits, cast in place items and other inserts.

D. Finish: Grind or sack as required as determined by the Architect to produce a smooth, straight, plumb and acceptable finish without burrs or form marks. For horizontal surfaces: provide float finish.

E. Curing: Cure surfaces utilizing one of the following methods:
1. Spraying: Spray water over slab areas and maintain wet for 7 days.
2. Spread polyethylene film over slab areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
3. Apply liquid curing compound at rate of 200 square feet per gallon, using power sprayer equipped with agitator. Do not apply liquid curing compound to surfaces scheduled to receive paving units or finish of any kind.

F. Flagpole bases: refer to Section 107500, Flagpoles for size of footings and cast in place items supplied by that section.

3.6 CURB AND GUTTER, CONCRETE CURB, CONCRETE DRAINAGE STRUCTURES, AND CONCRETE SWALES.

A. Subgrade Preparation: Subgrade material, base material and compaction requirements as approved by the Geotechnical Engineer.

B. Forms: Single face type required, cut to conform exactly with face batter and radius, sufficiently rigid to resist springing or deflection from concrete placement. Clean forms of all loose dirt, mortar or similar materials and apply a light coating of oil or other suitable material prior to concrete placement.

1. Slip Forms: Contractor's option upon approval of the Architect.

C. Reinforcement: Refer to drawings for size and spacing. Interrupt reinforcement at expansion joints.

D. Concrete Placement: Dampen subgrade to retain moisture in concrete mix. Tamp and spade to consolidate concrete to entire length of pour. Strike off upper surface to specified grades. Cut drain pipes to conform to curb batter.

E. Expansion Joints: Locate joint filler at maximum 20 foot centers. Trim off excess filler material flush to finish surface. No sealant application required.

F. Control Joints: at 8 feet on center, tooled joints, 1/2 inch radius.

G. Finish: Apply thin layer of mortar of 1 part portland cement to 1-1/2 parts sand to exposed faces. Trowel to a smooth and even finish with a fine hair broom applied parallel with the line of the work. Round all edges to 1/2 inch radius. No Contractor identification permitted.

H. Curing: Cure surfaces utilizing one of the following methods:

1. Spraying: Spray water over curb and gutter and maintain wet for 7 days.
2. Spread polyethylene film over areas, lapping edges and sides, minimum 6 inches and sealing with pressure sensitive tape; cover with plywood or otherwise protect film from damage; maintain in place for 7 days.
3. Apply liquid-curing compound at rate of 200 SF per gallon, using power sprayer equipped with agitator.

3.7 CONCRETE THRUST BLOCKS

A. Refer to Section 328423 Landscape Irrigation and drawings for locations.

B. Installed where the irrigation main changes direction as at ells and tees and where the irrigation main terminates. Pressure tests shall not be made for a period of 36 hours following the completion of pouring of the thrust blocks. Concrete thrust blocks for supply mains shall be sized and placed in strict accordance with the pipe manufacturer's specifications and shall be of an adequate size and so placed as to take all thrust created by the maximum internal water pressure.

3.8 TOLERANCES

A. Construction tolerances shall not violate dimensions, grades, slopes required by CBC for accessibility requirements. Adjust work accordingly to comply with requirements.

B. Comply with tolerances of ACI 117 and as follows:

1. Maximum deviation of 1/8 inch in 10 feet.
2. Elevation: 1/4 inch (6 mm).
3. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
4. Surface: Gap below 10-foot- (3-m-) long, unleveled straightedge not to exceed 1/8 inch (3 mm).
5. Lateral Alignment and Spacing of Tie Bars and Dowels: 1 inch (25 mm).
6. Vertical Alignment of Tie Bars and Dowels: 1/4 inch (6 mm).
7. Alignment of Tie-Bar End Relative to Line Perpendicular to Pavement Edge: 1/2 inch (13 mm).
8. Alignment of Dowel-Bar End Relative to Line Perpendicular to Pavement Edge: Length of dowel 1/4 inch per 12 inches (6 mm per 300 mm).
9. Joint Spacing: 3 inches (75 mm).
10. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
11. Joint Width: Plus 1/8 inch (3 mm), no minus.

END OF SECTION 32 05 23

SECTION 32 11 23
BASE COURSES

PART 1 – GENERAL

1.01 SUMMARY

A. Work shall consist of establishing subgrade, ensuring flow lines are maintained, performing weed abatement operations and furnishing, loading, hauling, and placing non-vegetative surface or sub-base materials.

B. Contractor shall provide all labor, materials, tools, equipment and incidentals for completion of Work.

1.02 RELATED WORK

A. Section 31 22 00 - Grading.

B. Section 32 12 16 – Asphalt Paving

1.02 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction (SSPWC), Latest Edition.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Material Test Reports: For each paving material.

1.04 QUALITY ASSURANCE

A. Contractor shall submit samples of materials to the City and Engineer for review and approval prior to purchase and installation.

B. Comply with materials, workmanship, and other applicable requirements of the City.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Aggregate base material shall be in accordance with the requirements of Section 200-2.4, Crushed Miscellaneous Base of the SSPWC and these special provisions.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Subgrade shall conform to compaction and elevation tolerance in accordance with these specifications and shall be free from loose or extraneous material.

B. Subbase materials shall be spread with a sufficient moisture content to obtain a relative compaction of not less than ninety-five percent (95%). Moisture content shall be uniformly distributed through the material.

C. Finish surface of subbase materials shall not vary more than two one-hundredth foot (.02') from grade specified on the drawings.

3.02 WEED ABATEMENT and SOIL TREATMENT

A. Contractor shall apply, in areas to be installed with non-vegetative materials, an approved selective pre-emergent, surface-applied herbicide. Application rate and method shall be as recommended by the manufacturer.

B. Visible weeds shall be sprayed with an approved non-selective, post-emergent herbicide. Application rate and method shall be as recommended by the manufacturer.

C. Contractor shall apply spray chemicals when air currents are still; preventing drifting onto adjoining property and preventing any toxic exposure to persons whether or not they are in, or near, the project.

D. Chemical treatments shall be applied to the satisfaction of the City and Engineer before placement of non-vegetative materials.

END OF SECTION 32 11 23

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Hot-mix asphalt paving.
   2. Aggregate base course.
   3. Wheel Stops.

B. Related Sections:
   1. Division 31 Section 31 22 00 "Grading" for aggregate subbase and base courses.
   2. Division 32 Section 32 17 23 “Pavement Markings”.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
   1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

B. Material Certificates: For each paving material, from manufacturer.

1.3 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of City of Palmdale for asphalt paving work.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

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

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:
   1. Tack Coat: Minimum surface temperature of 60 deg F.
   2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
   3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 40 deg F for oil-based materials, 55 deg F for water-based materials, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. Coarse Aggregate: ASTM D 692, sound; angular crushed stone, crushed gravel, or cured, crushed blast-furnace slag.

B. Fine Aggregate: ASTM D 1073, sharp-edged natural sand or sand prepared from stone, gravel, cured blast-furnace slag, or combinations thereof.

C. Crushed Miscellaneous Base (CMB): Crushed miscellaneous base shall consist of broken and crushed asphalt concrete or Portland cement concrete and may contain crushed aggregate base or other rock materials, 3/4 inch maximum grading, conforming to requirements of Section 200-2.4, SSPWC.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 or AASHTO MP 1a, PG 70-10.

B. Tack Coat: ASTM D 977 emulsified asphalt, or ASTM D 2397 cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Wheel Stops: Precast, air-entrained concrete, 2,500-psi minimum compressive strength, 4-1/2 inches high by 9 inches wide by 72 inches long. Provide chamfered corners, drainage slots on underside, and holes for anchoring to substrate.

1. Dowels: Galvanized steel, 3/4-inch diameter, 10-inch minimum length.

2.4 MIXES

A. Hot-Mix Asphalt: Dense, hot-laid, hot-mix asphalt plant mixes approved by authorities having jurisdiction and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course: Class B PG 64-10.
3. Surface Course: Class C2 PG 64-10.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 BASE COURSE

A. Place and compact aggregate base upon finished subgrade in conformance with Section 301-2 SSPWC. Compaction: 95 percent.

B. Thickness of Base After Compaction: As indicated on Drawings but not less than 4 inches if not indicated.

3.3 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.

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.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.4 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Spread mix at minimum temperature of 250 deg F.
   2. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either

"bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."

3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

G. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch.
2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch.
2. Surface Course: 1/8 inch.

3.8 WHEEL STOPS

A. Securely attach wheel stops to pavement with not less than two galvanized-steel dowels embedded at one-quarter to one-third points. Securely install dowels into pavement and bond to wheel stop. Recess head of dowel beneath top of wheel stop.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.10 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

END OF SECTION 32 12 16

SECTION 32 13 13 - CONCRETE PAVING & FORMWORK

PART 1 - GENERAL

1.1 SCOPE OF WORK

A. Furnish all materials, labor, and equipment required to provide complete concrete paving and curbs as shown on Drawings and as specified herein. See Drawings, schedules and details for types and locations of concrete work required. Furnish all labor, materials, equipment and supervision in accordance with these specifications and applicable Drawings.

B. Work Specified in This Section:

1. Concrete pavements, sidewalks and mow strips.

2. Concrete footings for site construction.

3. Concrete planter curbs.

4. Concrete planter walls or landscape walls.

C. Related Work in Other Sections

1. Earthwork.

2. Compacted base courses under paving.

D. Definition: The word Architect as used herein shall refer to the Landscape Architect or the Owner’s authorized representative.

1.2 COORDINATION

A. Fully coordinate work with all other trades involved. Coordinate with General Contractor items of other trades to be furnished and set in place. They shall execute portions of their work that is embedded, built in, attached to, or supported by the work of this section in ample time so that progress of the work is not delayed. Any cutting or patching made necessary to comply with this injunction shall be done at the General Contractor's expense. General Contractor shall be responsible for the proper installation of all accessories embedded in the concrete and for the provision of holes, openings, etc., necessary to the execution of the work of other trades.

1.3 GENERAL REQUIREMENTS

A. All concrete work shall be true to line and grade as indicated on the Drawings. The Contractor shall be responsible for proper drainage, without birdbaths, on all concrete paving surfaces. Any discrepancies or omissions on Drawings or conditions on the site that prevent the Contractor from providing proper drainage shall be brought to the

attention of the Owner's Representative in writing for correction or relief before work proceeds. All construction shall conform to current applicable codes and ordinances.

B. Piping: Do not embed piping, other than electrical conduit, in structural concrete. Locate conduit to maintain strength of structures to maximum. Verify size, length and location of electrical conduit. Sleeve any other piping.

C. Embedments: Anchor plates, inserts, and other items embedded in concrete shall be accurately secured so that they will not be displaced during placing of concrete.

D. Samples:

1. Furnish one 4'x4'x4" sample of each concrete finish with all specified joints in place at job site for approval from Owner's Representative.

2. Provide two 12"x12"x2" sample of each concrete color for approval by Owner's Representative.

3. Approved samples shall be standards for finishes and joints in concrete work, and shall remain job site until concrete work is complete.

E. Surface Tolerances: Finished paving surfaces shall not vary more than 1/4 inch when measured with a 10-ft. metal straightedge, except at grade changes. No "birdbaths" or other surface irregularities will be permitted. Correct irregularities to the satisfaction of Owner's Representative.

F. Surface Friction Coefficient: All concrete shall have a slip-resistant surface with a minimum friction coefficient of 0.6. Pool areas and ramps shall have a coefficient of 0.8.

G. Testing

1. The Owner's Representative will select a qualified testing laboratory to take samples for testing during the course of the work as considered necessary. The Owner's Representative will pay for costs of such tests. Contractor shall cooperate in making tests and shall be responsible for notifying the designated laboratory in sufficient time to allow taking of sample at time of pour.

2. Refer to Division 1 for specific requirements of testing.

3. Should tests show that concrete is below specified strength; Contractor shall remove all such concrete as directed by Owner's Representative. Full cost of removal of low-strength concrete, its replacement with concrete of proper specified strength, and testing shall be borne by Contractor.

4. The specifications and recommended practices of the American Concrete Institute (ACI), American Society for Testing and Materials (ASTM), The Uniform Building Code referred to in this specification with their individual designations are to be considered part of this specification. The latest revision of each recommended practice or specification shall apply.

PART 2 - PRODUCTS

2.1 PORTLAND CEMENT

A. Shall conform to current requirements of ASTM Designation C150, Type II cement with low alkaline.

B. Use same brand of cement from single source throughout entire project.

2.2 AGGREGATES

A. Coarse aggregate for concrete paving:

1. Shall be non-reactive aggregate. No Sun Valley aggregate shall be used. Contractor will submit a certificate stating that the aggregate has no history of reactivity and meets the ASTM standards

2. Coarse aggregate for regular-weight concrete shall be hard, curable, uncoated, washed, graded, cleaned, and screened crushed rock or gravel conforming to current requirements of ASTM Designation C33.

3. Coarse aggregate for paving shall not exceed 3/4 inch.

4. Use same aggregate from single source throughout entire project.

B. Aggregate for exposed aggregate finish shall be ¼” to 5/8” water-washed #4 pea rock with smooth edges.

C. Fine aggregate:

1. Sand shall be clean, hard, and durable with uncoated grains

2. Free from injurious amounts of silt, loam, clay or other deleterious matter,

3. Conforming to ASTM Designation C33,

4. Graded in size from coarse to fine with 95-100% by weight passing a No. 4 sieve, 45-70% passing a No. 16 sieve, 15-30% passing a No. 50 sieve, and 3-8% passing a No. 100 sieve.

5. Use same sand from single source throughout entire project.

2.3 WATER

A. Provide clean, potable concrete mixing water free from injurious amounts of salts, oils, acids, alkalis, organic materials, or other deleterious matter.

2.4 COLORING AGENTS

A. Only commercially pure mineral pigments shall be used to produce the desired color and in no case shall they exceed 10% of the cement content by weight. Color shall be

as specified on drawings. Coloring agent shall be used in strict conformity with manufacturer's specification.

1. Integral color admixtures for color-conditioned concrete: Davis Colors, Chromix by Scofield, Bomanite Integral Color, QC Integral Color, or product similar in design, construction, and performance.

2. Penetrating, acid stains for coloring new or old concrete (Lithochrome chemical stain by Scofield, Bomanite Chemical Stain, QC Patina Stain, or product similar in design, construction, and performance). Chemical stains applied to cured concrete shall be water solutions of metallic salts that penetrate and react with the concrete to produce insoluble, abrasion-resistant color deposits in the pores. Stains shall contain dilute acid to etch the concrete surface lightly so that the staining ingredients can penetrate deeper and react more uniformly.

3. Color wax for curing and finishing colored concrete flatwork (Lithochrome Colorwax, or product similar in design, construction, and performance) shall be a semi-transparent material designed to enhance the natural appearance of the surface to which it is applied. The color of the color wax shall be as near as possible to the color of the surface to which it is applied, to enhance the depth of color

4. Shake-on color hardeners for surface color conditioning shall be a streak-free intergrind of pigments, surface-conditioning and dispersing agents and Portland cement combined with hard, graded aggregate. Pigments are lime-proof and have maximum resistance to the effects of sunlight. (Lithochrome Color Hardener, Bomanite Color Hardener, QC Color Hardener, or product similar in design, construction, and performance)

2.5 SURFACE RETARDANTS

A. Water-based, film-forming surface retarder for flatwork, available in multiple depths of etch. Grace Pieri Top-Cast or product similar in design, construction, and performance.

B. In-form retarder, solvent-based, available in multiple depths of etch. Grace Pieri Euro-Tard or product similar in design, construction, and performance.

2.6 EXPANSION JOINT MATERIALS

A. Pre-molded expansion joint filler shall conform to ASTM D1751-6B size per Drawings. “Ethafoam Polyfelt” by White Cap, Inc., "Denver” foam backer rod by DFC, "Sonofoam" backer rod by Sonneborn, or approved equivalent.

B. Joint sealant compound shall be polyurethane two-part as manufactured by Sonneborn or approved equivalent. Color shall be per Drawings, or as approved by Owner’s Representative.

2.7 METAL DOWELS

A. Shall conform to current requirements of ASTM Designation A36.

B. Dowels at expansion joints shall be ½" diameter rebar free of dirt, grease and oils.

C. 50% of each dowel shall be encased in a "Speed Dowel" plastic sleeve, available from Greenstreak (888) 225-2193 or "Diamond Dowel System", available from Hub Construction Specialties (800) 889-4482, to allow parallel lateral movement of each dowel.

2.8 REINFORCING

A. Reinforcing bars shall conform to current requirements of ASTM Designation A615 deformed Grade 40 or Grade 60 billet-steel, clean and free from rust, scale, or coating that will reduce bonding.

B. Welded wire fabric shall conform to current requirements of ASTM Designation A185. Tags designating wire size and spacing shall be left on each roll until ready to use. Lap 6" on all edges.

C. Provide certified mill test reports regarding chemical and physical properties of all reinforcing bars and welded wire fabric furnished.

2.9 PRECAST CONCRETE

A. Precast concrete shall be used where indicated on the Drawings and may be used elsewhere with approval by Owner's Representative. Precast concrete must equal or exceed the specifications for concrete as stated herein. Precast concrete units shall be fabricated by a reputable manufacturer who shall submit conclusive evidence of successful completion of similar work, and who has the skill, craftsmanship, and equipment to fully comply with the Drawings and specifications.

B. Submit shop Drawings for all precast concrete items, and submit samples as specified for concrete herein.

C. All precast concrete items that abut or are adjacent to cast-in-place concrete shall be as indicated on Drawings. The Contractor shall allow adequate time for coordination of work and submission and approval of samples so that suitable uniformity of concrete work is obtained. Chipped or damaged precast units will not be accepted.

PART 3 - EXECUTION

3.1 DESIGN OF MIXES AND PROPORTIONING

A. Ensure that batch plant guarantees single source supply for cement, fine aggregate, and coarse aggregate for entire length of project

B. Proportioning and mixing of cement, aggregate, admixture, and water to attain required plasticity and strength shall be in accordance with the current edition of the ACI Manual of Concrete Practice and the PCA "Design and Control of Concrete Mixtures."

C. Concrete mixtures shall be designed by an approved commercial testing laboratory, using approved materials furnished by the Contractor, to obtain the specified minimum compressive strengths.

D. Maximum slump shall be 5", with ½ slump differential for successive batches.

3.2 FORM WORK

A. Forms shall be constructed accurately to dimensions and plumb and true to line and grade. Forms shall be substantial, mortar tight, braced, and tied so as to maintain position and shape during placing of reinforcing and concrete. Way surfaces and bulged walls or slab surfaces resulting from settlement or springing of formwork will not be acceptable.

B. The Contractor shall carefully examine Drawings and provide all recesses and all openings of proper sizes or shapes required or as may be directed by Owner's Representative for installation of all work requiring opening.

C. Forms shall be constructed and assembled in such a manner that construction joints shall occur at approved locations. Forms shall be thoroughly cleaned out before concrete is placed and forms shall be removed without damage to concrete.

D. Care shall be taken in all details of forming, setting, reinforcing, mixing, and placing all concrete exposed in finish work to obtain smooth, even surfaces of dense concrete, and clean sharp inside and outside corners, except where tooled corners are indicated. Concrete will be free of voids and irregularities.

E. Earth forms may be used for footings only where soil is firm and stable and concrete will not be exposed. Excavations shall be cut neat and accurate to size, and all exposed concrete shall be formed with the form extending at least six inches below finish grade.

F. Forms shall be carefully observed and checked for alignment and level as the work proceeds. All needed adjustment or additional bracing shall be done promptly.

G. After forms have been placed and approved, the Contractor shall see that all other trades have been properly notified and are given sufficient time to complete installation of their work. Placing of reinforcing steel shall proceed progressively with work of other trades and each shall arrange their working schedules so as to avoid disturbing or moving of work already installed by one trade to admit the work of another. Each trade shall be entirely responsible for proper installation and securing of the work and each shall keep his work under observation during placing of concrete.

H. Before pouring footings for foundations, see that bottoms of excavations are undisturbed earth free from water or frost, properly cleaned and leveled off, and compacted as required by the ACI building code. Do not place concrete on frozen earth or uncompacted fill.

I. Forms shall remain in place long enough to allow concrete to set properly and the Contractor shall assume all responsibility for removing forms. In no case shall

supporting forms or shoring be removed until concrete has sufficient strength to safely carry its own weight and the load upon it. Supporting vertical surfaces shall stay in place for 2 days minimum.

3.3 BASE PREPARATION

A. Subgrades shall consist of a minimum 4” layer of graded washed concrete sand compacted to 95% relative compaction. Sand shall be kept damp prior to concrete placement. All subgrades shall be graded to plus or minus 0.05”

B. Conform to all recommendations as noted in the soils engineer's report.

3.4 PLACING REINFORCEMENT

A. Place all reinforcement as shown on Drawings. Accurately place and securely fasten and support reinforcement to prevent displacement before or during pouring. Hang footing bars from forms. Support wire mesh with suitable metal cradles.

B. Clean, bend, and place reinforcement in accordance with current requirements of ACI Manual of Concrete Practice.

C. Reinforcement Splices:

1. Welded wire fabric - One-mesh minimum

2. Reinforcing bars:

a. #3 through #7 = 30-bar diameter

b. #8 through #9 = 40-bar diameter

c. #10 through #11 = 54-bar diameter

3.5 FINISHES

A. Steel Trowel Finish: After surface water disappears and floated surface is sufficiently hardened, steel trowel and re-trowel to smooth surface. After concrete has set enough, re-trowel to a smooth uniform finish, free of trowel marks or other blemishes. Avoid burned areas produced by excessive troweling.

B. Broom Finish: After surface water disappears and floated surface is sufficiently hardened, steel trowel and re-trowel to smooth surface. When ready, apply approved coarse texture finish by sliding a wire or stiff bristle broom in one direction along a straightedge guide set at right angles to the direction of traffic. On walkways, smooth finish 2" wide at edges, expansion joints, and score joints.

C. Sandblast: Refer to drawings for the areas to be sandblasted. Exterior landscape concrete surface shall be sandblasted as follows:

1. Landscape concrete walls shall be sandblasted to remove fines and board grains from surfaces.

2. Landscape paving surfaces shall be medium to light sandblasted to expose aggregate surface. Sandblast after saw cutting is done. See sample requirements in this section.

3.6 JOINTS

A. Score joints shall be formed in the fresh concrete using a jointer to cut the groove so that a smooth uniform impression is obtained. All joints shall be struck before and after brooming.

B. Expansion Joints and Edging: Expansion joints shall be formed provided at the location and intervals as shown on the Drawings and at all locations where concrete paving abuts buildings or other permanent vertical structures. Approved joint material shall be placed with top edge 1/4 in. below the paved surface, and shall be formed in the fresh concrete using an edging tool to provide a smooth uniform impression. All edges shall be struck before and after brooming. After the curing period, expansion joints shall be carefully cleaned and filled with approved backer rod and joint compound flush with the paved surface in such a manner as to avoid spilling on paved surfaces or overflow from joint.

C. Sawcut joints: Sawcut all joints as shown on Drawings. Sawing shall be done as soon as the surface is firm enough not to be torn or damaged by the blade. Sawcut joints before sandblasting.

3.7 CURING AND PROTECTION

A. General: Protect concrete against frost, rapid drying, and rain damage, and keep moist for at least seven (7) days after placing. Protect concrete during this period by wet burlap, canvas covering, or liquid curing compound. Secure Owner’s Representative's approval of proposed methods. During this period maintain concrete above 70 F for at least three days or above 50 F for at least five days. Concrete from which forms are removed within seven (7) days after pouring shall be sprayed during the curing period as frequently as drying conditions may require. Concrete covering shall be a type that will not stain or discolor finished concrete surfaces. Cure concrete in accordance with requirements of the current ACI Manual of Concrete Practice.

B. Metal Form Ties: Metal form ties extending from the face of permanently exposed concrete shall be cut off at least one inch deep in the concrete immediately after removal of forms. Fill holes with a 1:3 cement and sand mortar as dry as possible and finish flush with the adjacent surface.

C. Defects: All defects in concrete work shall be corrected. Voids shall be chipped to sound concrete and to a depth of at least one-inch with the edges perpendicular to the surface and parallel to form markings. Repairing voids and rubbing shall be done as directed by the Owner’s Representative, and shall be done at the Contractor's expense. Concrete surfaces so repaired shall duplicate the appearance of the unpatched work.

END OF SECTION 32 13 13

SECTION 32 17 23 - PAVEMENT MARKINGS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Parking-stall line and curb painting.

B. Traffic symbols, directional arrows, lettering and safety zones, loading zone.

C. Accessibility signage.

D. Fire lanes.

E. Paint for Traffic Striping.

F. Raised Pavement Markers.

1.2 REFERENCES

A. SSPWC - Standard Specifications for Public Works Construction, 2007 Edition.

B. AQMD - Air Quality Management District.

C. Fed. Std. 595B - Colors Listed in Government Procurement.

D. CACRM - California Access Compliance Reference Manual, updated on July 1, 2008 based on 2007 California Building Code.

E. MUTCD - Department of Transportation, Manual for Uniform Traffic Control Devices.

F. CSS - Caltrans Standard Specifications, Latest Edition.

G. IR 11B-7 – Requirements for Accessible Parking Spaces.

1.3 SUBMITTALS

A. Product data.

B. Shop drawing layout of complete parking lot, indicating stalls, lettering, safety zones, directional arrows, widths of lines and colors.

1.4 QUALITY ASSURANCE

A. Product Manufacturer: Company specializing in manufacturing quality traffic line paint products with ten years experience.

B. Applicator: Company specializing in commercial pavement painting with five years experience.

C. Regulatory Requirements
   1. Conform to Federal Regulations concerning lead content of paints.
   2. Conform to AQMD, Local Regulations. Copy of regulation is on file at Architect's office.

D. Field Samples
   1. rovide field sample in form of one parking lot stall, illustrating coating color, width of stroke, thickness of application and dimensioning.
   2. Locate where approved.
   3. Accepted sample may remain as part of Work.
   4. Do not proceed with pavement marking until sample markings has been approved.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in sealed and labeled containers.

B. Container labeling to include manufacturer's name, type of paint, brand name, brand code, coverage, surface preparation, drying time, cleanup, color designation and instructions for mixing and reducing.

C. Store paint materials at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, unless otherwise recommended by manufacturer.

1.6 REGULATORY REQUIREMENTS

A. Paint products shall produce a coated finish as slip resistant as surrounding pavement.

1.7 EXTRA STOCK

A. Provide one gallon unopened container of each color to Owner.

B. Label each container with color in addition to manufacturer's label.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products of following manufacturers form basis for design and quality intended.
   1. Dunn-Edwards Corporation, Los Angeles, CA.
   2. ICI/Sinclair Paint, Commerce, CA.
   3. Frazee Paint and Wallcovering, Inc., Anaheim, CA.

B. Or equal as approved in accordance with Division 01, General Requirements for Substitutions.

2.2 MATERIALS

A. Traffic Line Paint: Waterbourne emulsion type, lead and chromate free, ready mixed, complying with Fed. Spec. TT-P-1952 drying time less than 45 minutes. Color as shown. Paint shall be in containers of at least 18 L (5 gallons). A certificate shall accompany each.
   1. Dunn-Edwards: VIN-L-STRIPE TRAFFIC PAINT, VINYL EPOXY EMULSION, W801.
   2. ICI/Sinclair: NO. 160 VINYL TRAFFIC PAINT.
   3. Frazee: No. 506 TRAFFIC LINE PAINT.

B. Striping, pavement markings, and curb markings in accordance with Sections 210-1.6 and 310-5.6 SSPWC.

C. Raised Pavement Markers: In accordance with Caltrans Section 85, Rectangular "Highway" Raised pavement markers, beveled edges, prismatic, dual reflective lenses, White and blue for fire hydrant location, 4" x 4" x 3/4". High-impact plastic, ASTM D788, Grade 8. Cal Trans Type D or G.

1. Hy-Viz, Lodi, NJ. Or equal.
2. Adhesive: Epoxy type, rapid set, CalTrans Sections 85-1.055, 95-2.04, ASTM C881, Type IV Grade, 3, Class B.

D. Substrate: Asphalt.

2.3 COLORS

A. ACcessible Stalls and Signage: Blue, conforming to No. 15090 Fed. Std. 595B and California Building Code Section 1129B.4.

B. Parking stalls, lettering, arrows, passenger loading zones and traffic signage: White.

1. Accessible Parking spaces: Border (perimeter) shall be blue, hatching shall be blue. Markings and lettering according to CBC Section 1129B.4 and IR 11B-7.

C. Stalls: Single line, 4 inches wide unless double lines are noted on drawings.

D. Fire Lanes: Red; paint curbs or paint 6 inch red strip if no curb. Paint 4-inch high stenciled white letters on curbs and strip indicating, "Fire Lane - No Parking" at 20 feet on center.

E. Temporary Parking: Green painted curbs, with 4-inch high stenciled white letters, indicating, "Temporary Parking 20 Minutes", at designated stalls.

F. Loading Zone: White, paint curbs, with 4-inch high stenciled black letters, indicating, "Loading Zone – No Parking", at 30 feet on center.

PART 3 - EXECUTION

3.1 INSPECTION

A. Verify that surfaces are ready to receive Work as instructed by product manufacturer.

3.2 APPLICATION

A. Surfaces to be painted shall be clean and free of dust, dirt, grease, oil, water or other contaminates.

1. Existing lines to be removed shall be sandblasted clean.

B. Traffic paint shall not be applied until seal coat has been in place minimum of 10 days.

C. Apply material by machine spray, airless sprayer, roller or brush to provide a minimum thickness of 15 mils average. Precise edges required, no overspray allowed.

D. Perform Work in accordance with approved Shop Drawings. Conform to Section 310-5.6.8, SSPWC and CACRM.

E. Mark parking spaces for disabled according to CBC Section 1129B.4.

F. Painted lines and markings on pavement shall be 4 inches minimum wide and blue in color equal to color No. 15090 per Federal Standard 595B.

G. Raised Pavement Markers: Install in accordance with Caltrans Section 85-1.06 with rapid set epoxy adhesive.

3.3 DEFECTIVE WORK

A. Remove any paint that demonstrates evidence of checking, cracking, peeling, discoloration, lack of bonding or poor coverage. Misplaced lines shall be completely removed by paint remover or wet sandblasting per Section 310.5.6.3, SSPWC. Painting over misplaced lines will not be permitted.

END OF SECTION 32 17 23

SECTION 33 10 00
WATER UTILITIES

PART 1 – GENERAL

1.01 SUMMARY

A. Water distribution shall consist of furnishing and installing site water lines as shown on the drawings and as specified herein, including but not limited to piping materials, valves, fittings and related appurtenances, connections to existing water, excavation and backfill of trenches, as-builts, record drawings, guarantees, permits and licenses, testing, and clean-up operations.

B. Contractor shall provide all labor, materials, tools, equipment and incidentals for completion of Work. Coordinate with Newhall County Water District (NCWD) as to the service installation by their forces and the portions of water system to be constructed by Design-Builder. Pay

1.02 REFERENCE STANDARDS

A. Standard Specifications for Public Works Construction (SSPWC), Latest Edition.

B. California Plumbing Code (CPC), Latest Edition.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

C. Test Reports: Indicate results comparative to specified requirements. Comply with requirements of serving water utility and public health authorities having jurisdiction.
   1. Disinfection Report
   2. Bacteriological Report

D. Certificate of Compliance: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

E. Project Record Documents: Record actual locations of piping mains, valves, connections, thrust blocks, and invert elevations. Identify and describe uncharted utilities.

F. Design Builder to prepare plan showing complete parking structure requirements detailing what portions to be constructed by NCWD and portions by Contractor.

G. Contractor to pay applicable fees to NCWD for the new service and facilities.

1.04 QUALITY ASSURANCE

A. Regulatory Requirements: Products and installation of water system shall comply with all applicable requirements of serving agency. Where products or installation details are not

indicated, comply with standard specifications and standard details as adopted serving agency.

B. Inspection:

1. Allow access to the inspector at all times during progress of the Work.

2. Notification shall be made at least two working days prior to desired inspection.

3. Work covered or backfilled prior to inspection shall be uncovered for inspection.

C. The Contractor installing the Work shall have a valid Class C-34, C-36 or A license in California

PART 2 - PRODUCTS

2.01 BEDDING MATERIALS

A. Bedding: Sand, 6 inches minimum thickness below piping and 12 inches minimum thickness above top of pipe, compacted to 90%.

B. Cover: Native material as approved by the Geotechnical Engineer. Fill in 8-inch lifts to specified subgrade elevation and compacted to 90%.

2.02 PIPING AND FITTINGS

A. Pipe and Pipe Fittings, General: Pipe and pipe fittings shall be as indicated on Civil Drawings and shall comply with applicable American Water Association (AWWA) standards, standards and specifications of the serving water utility. Pipe fittings shall be compatible with each other.

B. Trace Wire: Magnetic detectable conductor, brightly colored plastic covering, imprinted with "Water Service" in large letters, complying with requirements of serving water utility.

2.03 DISINFECTION CHEMICALS

A. Chemicals: As required by serving water utility and public health authorities having jurisdiction.

PART 3 - EXECUTION

3.01 PREPARATION

A. Layout: Examine the Drawings and inspect field conditions. Determine that the water system will not interfere with other utilities, including the storm drain system.

1. If conflicts are discovered, propose to City and Engineer what field adjustments in water pipe routing or grade changes should be made to eliminate interference with

other underground utility systems, building construction, existing conditions and other Work.

2. Discuss proposed field adjustments with City and Engineer prior to implementation.

3. Record changes on Project Record Drawings.

B. Verify that service connection and utility water main size, location, and invert are as indicated.

3.02 DOMESTIC WATER SYSTEM INSTALLATION

A. General: Comply with requirements of the serving water utility, including standard specifications and standard details, standard specifications and standard details of serving water utility.

B. Connection to Existing Mains: Connect new mains to existing mains in compliance with standard specifications of serving utility.

1. Connection to Existing Mains: Contractor shall connect new mains to existing mains at locations shown on Drawings. Whenever possible, hot taps will be preferred method of connection. Hot taps shall be made by skilled operators under the direction of a competent foreman and with personnel of serving water utility standing by.
2. Notification: Contractor shall give notification to City and Engineer not less than three days in advance of these operations. Advance notice shall also be given to customers to be affected by shutdown. Contractor shall stipulate the expected duration of the shutdown.
3. Existing fittings: Where existing mains are provided with fittings for the purpose of connecting to new main, Contractor shall remove plugs or bulkheads, clean ends, prepare fittings for connection of new main, and make new connection.

3.03 TRENCHING

A. Hand trim excavation for accurate placement of pipe to elevations indicated.

B. Form and place concrete for pipe thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide thrust restraint bearing on subsoil.

C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 PIPE INSTALLATION

A. Maintain separation of water main from sewer piping in accordance with applicable codes.

B. Group piping with other site piping work whenever practical.

C. Establish elevations of buried piping to ensure not less than minimum cover required.

D. Install pipe to indicated elevation to within tolerance of 5/8 inches.

E. Install ductile piping and fittings in compliance with Standard Specifications of serving water utility.

F. Route pipe in straight line.

G. Install pipe to allow for expansion and contraction without stressing pipe or joints.

H. Install access fittings to permit disinfection of water system.

I. Slope water pipe and position drains at low points.

J. Install trace wire 6 inches above top of pipe.

3.05 VALVE INSTALLATION

A. Set valves on solid bearing.

B. Center and plumb valve box over valve. Set box cover flush with finished grade.

3.06 SERVICE CONNECTIONS

A. Provide water service to utility company requirements with approved reduced pressure backflow preventer.

3.07 FIELD QUALITY CONTROL

A. Tests, General: Perform field inspection and testing in accordance with general requirements of serving water utility.

B. Piping Tests: Conduct piping tests before joints are covered and after thrust blocks have hardened sufficiently. Fill pipeline 24 hours prior to testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Testing:

1. Pressure Test: No section of the pipe shall be tested until at least five days have elapsed since placing of concrete thrust blocks.
   a. Each pipeline or section thereof shall be pressure-tested by Contractor according to requirements of serving water utility, with working pressure measured at highest point, for at time duration as required by serving water utility and in accordance with ANSI/AWWA Specifications C600.
   b. Contractor shall make all necessary taps, and supply test pump, pipe connections and test pressure gage. Testing laboratory will witness pressure-testing of pipelines.
   c. Testing shall be conducted after satisfactory completion of the disinfection of pipeline. Serving water utility shall fill pipeline with water and no external pressure shall be applied for 36 hours before testing begins.

2. Expelling Air Before Test: Before applying the specified test pressure, all air shall be expelled from pipeline. If hydrants or blow-offs are not available at high points, Contractor shall provide necessary taps at points of highest elevation before the test is made, and insert plugs after the test has been completed. Temporary blow offs

and/or taps which are not shown on the Drawings may be needed for various testing. Contractor shall be responsible to install and remove these as directed by serving water utility.

3. Examination Under Pressure: All exposed pipes, fittings, valves, hydrants and joints shall be carefully examined during test. All service shall be visually checked while water main is under test pressure. All cracked or defective pipes, fittings, valves, services, or hydrants discovered in consequence of this pressure test shall be removed and replaced by the Contractor with sound material, and the test shall be repeated until satisfactory to serving water utility.

4. Leakage Test: Leakage test shall be conducted after the pressure test has been satisfactorily completed in accordance with ANSI/AWWA Specifications C600 and requirements of serving water utility. Contractor shall supply pump, gage, pipe, connections, and all other necessary apparatus, and shall conduct the test.
   a. The duration of each leakage test shall be as directed by serving water utility, and during the test water main shall be subjected to pressure and maintained at pressure as directed by serving water utility.
   b. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof, necessary to maintain the specified leakage test pressure after the pipe has been filled with water and the air expelled.

5. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to City.

6. Allow access to the inspector at all times during progress of the Work.

3.08 PURGING, CLEANING AND DISINFECTING

A. Purging, Cleaning and Disinfecting, General: As directed by serving water utility and public health authorities having jurisdiction. Prepare and submit reports of purging, cleaning and disinfecting activities.
   1. Verify that piping system has been cleaned, inspected, and pressure tested.
   2. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

B. Disinfection of Water Lines.
   1. Provide and attach required equipment to perform the work of this Section.
   2. Inject treatment disinfectant into piping system.
   3. Maintain disinfectant in system for 24 hours.
   4. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
   5. Replace permanent system devices removed for disinfection.

C. Testing: Test water samples in accordance with requirements of serving water utility and public health authorities having jurisdiction.

END OF SECTION 33 10 00

SECTION 33 40 00
STORM DRAINAGE UTILITIES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Furnish and install the site drainage system as shown on the drawings and as specified herein, including but not limited to excavation and backfill of trenches, piping, fittings, manholes, accessories, bedding, connection to existing systems, as-builts related to appurtenances, record drawings, guarantees, permits and licenses, testing, and clean-up operations.

B. Contractor shall provide all labor, materials, tools, equipment and incidentals for completion of Work.

1.02 RELATED WORK

A. Section 31 22 00 - Grading.

1.03 REFERENCES

A. Standard Specifications for Public Works Construction (SSPWC), Latest Edition.

B. Standard Plan for Public Works Construction (SPPWC), Latest Edition.

1.04 SUBMITTALS

A. Manufacturers' technical data and material specifications on pipe materials, pipe fittings, drain inlets, and accessories.

B. Contractor shall provide the Engineer with Manufacturers' Certificates certifying that products meet or exceed specified requirements.

C. Shop drawings and as-builts / record drawings recording actual locations of piping mains, catch basins, connections and invert elevations.

D. Casing pipe, connection details and casing spacers to be used.

PART 2 – PRODUCTS

2.01 MATERIALS

A. HDPE pipe shall conform to the requirements of Section 207-18, Annular High Density Polyethylene Pipe With Smooth Interior, Corrugated Exterior, With Bell and Spigot Joints (Type S) of the SSPWC and these special provisions,

B. Inlets shall be in accordance with the contract drawings.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations as indicated on drawings.

3.02 PREPARATION

A. Hand trim excavations to required elevations. Correct over excavation with fine aggregate.

B. Remove large stones, rocks, or other hard matter which could damage piping or impede consistent backfilling or compaction.

3.03 PIPE INSTALLATION

A. Construct trench per SSPWC Section 306-3, Trench Excavation.

B. Install pipe to indicate elevation to within tolerance of one-eighth inch (1/8").

C. Install pipe starting at the downstream end working upstream.

D. Installation of HDPE piping shall conform to the requirements of SSPWC Section 207-18, Annular High Density Polyethylene Pipe With Smooth Interior, Corrugated Exterior, With Bell and Spigot Joints (Type S).

E. Install pipe to allow for expansion and contraction without stressing pipe or joints.

F. Lay pipe to slope gradients noted on drawings with maximum variation from true slope of one-eighth inch (1/8") in ten feet (10').

G. Backfill trench in accordance with SSPWC Section 306-12, Backfill. No backfill will be allowed without prior approval from the City and Engineer.

H. Route pipe in a straight line.

3.04 SERVICE CONNECTIONS

A. Verify points of connections before laying pipe.

B. Connect to building drain outlets, site catch basins and inlets and existing drainage system per drawings and in accordance with all local requirements.

1. Connection to existing drainage facilities shall be in accordance with SPPWC (Greenbook), Standard Plans.

3.05 CLEANING

A. Before testing is performed, clean installed piping and ensure that piping is unobstructed.

3.06 FIELD TESTING

A. Pipeline testing shall be in accordance with the requirements of SSPWC Section 306-7.8, Gravity Pipeline Testing. Test report will be submitted to Engineer for review and approval.

B. If tests indicate work does not meet specified requirements, remove work, replace and retest.

3.07 PROTECTION

A. Protect pipe and aggregate cover from damage or displacement until backfilling operation is in progress.

END OF SECTION 33 40 00